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TARMO STRENZE

Intelligence and socioeconomic success

A study of correlations, causes and consequences

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LIST OF ORIGINAL PUBLICATIONS

The dissertation in based on the following original publications which will be marked in the text by the Roman numerals.

I Strenze, T. (2006). Who gets ahead in Estonia and America? A comparative analysis of mental ability and social origin as determinants of success. *Trames: A Journal of the Humanities & Social Sciences*, 10, 232–254.

II Strenze, T. (2007). Intelligence and socioeconomic success: A meta-analytic review of longitudinal research. *Intelligence*, 35, 401–426.

III Strenze, T. (2013). Allocation of talent in society and its effect on economic development. *Intelligence*, 41, 193–202.

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Author's contribution
The author of this dissertation is the sole author of all the above publications.

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In the final stages of writing I received valuable comments from Veronika Kalmus, Olev Must, Pille Pruulmann-Vengerfeldt and Ellu Saar.

The original topic of my dissertation was “theory of action”. Over time it was narrowed down to “intelligence and socioeconomic success”. Looking at this thematic evolution (and the time it took), I am grateful to the Institute of Sociology and Social Policy for providing me with an open intellectual environment that has allowed my thoughts to evolve.

1. INTRODUCTION

To some people the English word "intelligence" brings to mind espionage, secret agents, counter intelligence and CIA. The present dissertation is not about that kind of intelligence. In this dissertation the word "intelligence" refers to mental abilities, intellectual achievements, IQ tests, and the like. But no need to be disappointed. Intelligence (of the second kind) is one of the most controversial topics in the social sciences. Many writings on intelligence start with observations like "*Intelligence has been a much debated construct in all of its history. Some swear by it, others swear at it.*" (Viswesvaran & Ones, 2002: 211), "*Few topics have sparked such heated debate within the academic community and society at large as that of intelligence and intelligence testing.*" (Schlinger, 2003: 15), "*Few debates in the history of science have been conducted with such stupidity as the one about intelligence.*" (Ridley, 1999: 77). The IQ debate (or "IQ war" as some have called it) started at the beginning of the 20th century and continues to this day over questions like: do IQ tests measure intelligence, is intelligence genetically determined, can intelligence be changed, are whites more intelligent than blacks?

The present dissertation focuses on the following question: are intelligent people more successful than less intelligent people? A lot of scientific research has addressed this question and the simple answer to the question is a firm "yes": intelligent people are indeed more successful than less intelligent people. In other words, there is a positive relationship (correlation) between intelligence and success. However, that simple fact is actually not that simple, there are many details about this fact that need to be discussed. The causes of the positive relationship between intelligence and success are not entirely understood, despite many decades of research, and the consequences of that relationship for society are just beginning to be studied.

"Success" can be defined in various ways. The present dissertation is devoted mainly to one form of success: the so called "socioeconomic success". That is success in educational and occupational world – receiving a good education, getting a decent job and making enough money. The general aim of this dissertation is to contribute to the scientific knowledge on the relationship between intelligence and socioeconomic success.

To attain systematic knowledge about something, one has to pursue three goals: describe the thing of interest, analyze the causes of the thing, and analyze the consequences of the thing. Following this simple logical schema, we can set up three specific goals for the present dissertation:

> First, to describe the relationship between intelligence and socioeconomic success – how strong is the relationship, how it compares to the relationship with other measures of success and other determinants of success?

Second, to analyze the causes of the relationship – what mechanisms explain the relationship between intelligence and socioeconomic success?

Third, to analyze the social consequences of the relationship – how the existence (or absence) of the relationship between intelligence and socioeconomic success influences society?

The dissertation is based on three original studies (Strenze, 2006, 2007, 2013, or studies **I**, **II**, **III**, respectively). These studies are rather different from one another but they all deal with the relationship between intelligence and socioeconomic success in some way. The original studies contribute to the three goals of the dissertation in the following manner: the first goal (description) is achieved through studies **I** and **II**, the second goal (causes) through study **II**, and the third goal (consequences) through study **III**.

The topic of the relationship between intelligence and socioeconomic success is a multidisciplinary topic that joins the psychological study of human mind to the sociological study of human behavior in society. The present dissertation has to find an appropriate balance between psychology and sociology. That is why the dissertation will not go very deeply into the psychological mechanisms underlying intelligence (although, a short review will be given in chapter 2.1). Likewise, the dissertation will not delve into the sociological meaning of success (aside from brief remarks in chapter 2.2). The main concern of the dissertation is the *relationship* between intelligence and success, not either of them separately.

The introductory chapters of the dissertation are structured as follows. Chapter 2 will elaborate on the theoretical and empirical context of the original studies. More specifically, it will discuss the meaning of intelligence and success (chapters 2.1 and 2.2), describe the relationship between intelligence and socioeconomic success (2.3 and 2.4), analyze the causes of the relationship (2.5 and 2.6) and its consequences (2.7). Chapter 3 will review the aims, methods and results of the original studies. Chapter 4 will present conclusions.

2. INTELLIGENCE AND SUCCESS: REVIEW AND DISCUSSION OF RESEARCH

This chapter of the dissertation serves as a general review and discussion of the research on intelligence and socioeconomic success. The results from the original studies of the dissertation are included in this review to allow the reader to see what the original studies contribute to this research.

2.1. What is intelligence?

In order to provide some background it is necessary to start by discussing the nature and definition of intelligence. My treatment of these topics will naturally be brief, for more detailed reviews see Jensen (1998) or Sternberg & Kaufman (2011). Scientists from different fields and of different persuasion have given various definitions to intelligence (see Legg & Hutter, 2007). A good description of what is generally meant by intelligence is offered by Gottfredson: "*Intelligence is a very general mental capability that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience. It is not merely book learning, a narrow academic skill, or test-taking smarts.*" (Gottfredson, 1997: 13). Some prominent researchers would probably not agree with this definition (e.g., Flynn, 2007), but I find the definition useful as a starting point because it includes the basic attributes that are necessary for the concept of intelligence to be meaningful.

First, as the above definition states, intelligence is *capability* or *ability*, not book learning or academic skill. Ability is the potential to do something in case of sufficient motivation and opportunity (Carroll, 1993). Intelligence is the potential to think, comprehend, learn and perform other mental operations. It must be distinguished from knowledge and skill, which refer to the specific information the person has already learned, while intelligence is the potential to learn any information (see Furnham & Chamorro-Premuzic, 2006). Second, intelligence is *general* ability, not specific ability that is related only to a particular task or field. Each person has one overall level of mental ability and that ability is not specialized to any particular activity. In addition to that general ability, people also have more specific abilities, such as verbal or numerical ability (see Willis et al., 2011, for a review). This dissertation will be limited to general ability.

Another important attribute of intelligence is that it *differentiates* people, it is not the same for all people, some have more intelligence than others. In other words, intelligence is an "individual difference variable", a variable that has been invented mainly to characterize how people differ from one another (see Maltby et al., 2007). To measure individual differences in terms of this variable, psychologists have constructed IQ tests. Much of what will be said in the

dissertation is dependent on the assumption that IQ tests are more or less adequate measures of intelligence. Not everyone agrees with that assumption, however, there has been a lot of dispute if IQ tests really measure general ability, like they are meant to, or do they measure specific knowledge and skills (see Urbina, 2011, for a short review). This dissertation cannot resolve this dispute or discuss the nature and construction of IQ tests at any length. Let us proceed on the assumption that testing intelligence is possible, even if some IQ tests do not live up to the expectation. Perhaps the problems with IQ testing can be alleviated if traditional IQ tests are replaced by more objective biological measures of intelligence (Matarazzo, 1992).

Now, having defined intelligence in such a manner, an important question presents itself – does intelligence like that really exist, what is the basis for saying that each person can be characterized by a single level of general mental ability? That is a critical question and, indeed, some authors have said that intelligence (defined in the above manner) does not exist (e.g., Gould, 1981; Schlinger, 2003). So let me present what many believe is the main argument for the existence of intelligence. When a group of people is given a number of mental tasks to solve, then what usually happens is that some people do it better than others and those people who are better in one task are also better in the second task and the third task and so on. In other words, there is a positive correlation between the scores of those different tasks. This phenomenon was first studied by Spearman (1904) and has since become one of the major findings of test research. In a huge meta-analysis of 460 data sets from previous studies, Carroll found that there is a uniform tendency for different ability tests to correlate positively with one another (Carroll, 1993). Other meta-analyses that have obtained the same result include Kuncel et al. (2001) and Ackerman et al. (2005). Similar positive intercorrelations have been found in education – students' results in different school subjects tend to correlate positively with one another (Deary et al., 2007). The tendency for positive correlations can also be observed over time – when the same individuals are given the same or similar test after some time, then those who got better results the first time, will also get better results the second time, even if the time interval between the first and second testing is several decades (Deary et al., 2000).

Where do these correlations come from? Why do some people get consistently better results than others? To answer that question, Spearman (1904) came up with the concept of general intelligence, or g-factor as it is often called. General intelligence is the "mental energy" within people that fuels the solving of all intellectual tasks and people who have more of this energy get better results in most tasks. In factor-analytic terms, it is the unobserved hypothetical construct that explains the positive correlations among tasks (Jensen, 1998). That is one explanation for the positive correlations. An alternative explanation would be social environment – people who live in safe, healthy and culturally stimulating environment are better prepared to solve any kind of intellectual tasks. Thus, in this case the source of the correlations is not

within the person but outside of him or her; and IQ tests are really measures of social advantages and disadvantages, not of some ability inside the person (Block & Dworkin, 1976; Richardson, 2002). The present dissertation is not in a position to decide conclusively which of these explanations is correct. But the opposition between these two views is of central importance for this dissertation because it has been the main source of dispute throughout the IQ debate.

Probably the best known opposition of the IQ debate is the nature-nurture question – what is the ultimate source of intelligence, genes or environment? This question has been on the forefront of intelligence research since the first half of the 20th century and continues to attract attention. Intelligence certainly would not be such a controversial subject if there was no reason to believe that it is, to a considerable degree, determined by genetic factors. Dozens of behavior genetic studies have tried to determine the heritability of intelligence (see meta-analyses in Bouchard & McGue, 1981; Devlin et al., 1997). The estimates of heritability (percentage of the variation in IQ scores that is explained by variation in genes) vary considerably. Some researchers have suggested that it could be as high as 0.80 (Jensen, 1969), but most have come up with lower estimates around 0.50 (Devlin et al., 1997). The consensus seems to be that about half of the variation in intelligence comes from genes. The other half is left for the environmental influences, such as parental wealth, home atmosphere, and the like (see meta-analyses in White, 1982; Kall, 2010).

Another, less controversial, topic in the IQ debate is the consequences of intelligence. By that I mean the consequences of individual differences in intelligence – what differences between people are caused by the fact that people do not have the same level of intelligence? This is, of course, the central topic of the present dissertation and will be covered in the following chapters. Here, let me just state the two main views. One view is that intelligence is highly consequential for people in their everyday lives, those with higher intelligence achieve all sorts of desirable outcomes thanks to their ability to overcome the hardships that life might set up for them. The other view is that intelligence is really not that important; intelligent people may usually achieve more desirable outcomes than less intelligent people, but that is not because of their superior intelligence, but for some other reason, such as rich parents. These two views will be discussed later in relation to socioeconomic success (see chapter 2.5).

To end this chapter, take a look at Table 1 which presents some of the central topics of the IQ debate from the two opposing points of view. The statements in both columns of Table 1 usually come in packages, such that a researcher who supports one of the statements in the column is likely to support the other statements in the same column. I am myself not committing to either one of these extreme views on intelligence, rather, these views are presented here to provide a general background for the results that will be discussed later. One thing we should remember from this table is that the question about the relationship between intelligence and success – the topic of the present

dissertation – is closely connected to other questions about intelligence; our interpretation of the relationship between intelligence and success is dependent on our beliefs regarding the other topics of the IQ debate.

Table 1. Overview of the opposing views on some of the central problems regarding intelligence.

– Each person can be characterized by general mental ability (Jensen, 1998).	– There is no such thing as general mental ability (Gould, 1981).
– IQ tests are reasonably good measures of that ability (Eysenck, 1979).	– IQ tests are really measures of social environment (Block & Dworkin, 1976).
– Correlations among tests are proof of the existence of general ability (Carroll, 1993).	– Correlations among tests are the result of environmental influence (Richardson, 2002).
– Genetic effects on IQ scores are large (Jensen, 1969).	– Genetic effects on IQ scores are not that large (Devlin et al., 1997).
– Intelligence has a causal effect on success in many areas of life (Gottfredson, 2003).	– The correlation between IQ scores and success does not represent a causal effect (McClelland, 1973).

2.2. What is success?

Before going on to the relationship between intelligence and success, I should say a few words about the concept of "success". Contemporary western society is often said to be highly success-centered, there is even talk about the "cult of success" (Sutrop, 2004). In a wider sense of the term, success is present in every society. Success can be defined as doing or achieving something that is generally considered desirable in the society. Naturally, there are many ways to be successful. This dissertation is mostly devoted to socioeconomic success – success in the field of education and work – but other forms are also discussed. Some readers may be tempted to say that success is a purely subjective phenomenon, which each individual defines for oneself. There is certainly some truth to this statement, but it seems that there is usually a high degree of consensus in society as to what is desirable and what is not. This consensus provides individuals with socially accepted goals to strive for (Merton, 1938). Even if there are individuals who reject some form of success (for instance, claim that they do not care about money), that form of success still remains socially relevant and worthy of study.

The present dissertation focuses mostly on socioeconomic success. "Socioeconomic success" is a vague term that usually refers to success in the educational and occupational sphere. It can also be termed "career success" if by career we mean occupational as well as educational career. Another related term is "status attainment" – attaining social status. The main indicators of socio-

economic success are education, occupation and income attained by the person in adulthood. In addition to these, socioeconomic success could also be defined as promotions received at work, upward social mobility, being employed (as opposed to unemployed), etc.

It should also be noted that "success" is closely related to social inequality: if some people are more successful than others, then there is inequality between them. That is especially true of socioeconomic success because differences between people in terms of education, occupation and income are at the very heart of the study of social inequality and stratification. Therefore, a study of success is a study of social inequality; if intelligence contributes to people's success, then it means that intelligence creates inequality between people.

2.3. Intelligence and various forms of success

So what is the evidence for the relationship between intelligence and success? Hundreds of studies have examined the relationship between intelligence and some form of success; it is obviously impossible to review all of these studies here. I will concentrate on meta-analyses (quantitative reviews of previous research) because results from meta-analyses are more reliable than results from single studies. Table 2 presents a list of meta-analytic correlations between IQ scores and various outcomes that can reasonably be designated as "success" or lack of success. Of course, several important forms of success have never been subjected to meta-analysis and are, consequently, absent from Table 2. On the other hand, some forms of success have been meta-analyzed more than once, in which case I chose the largest meta-analysis. What interests us most in Table 2 is the comparison of correlations with socioeconomic success to correlations with other forms of success.

Overall, it is evident from Table 2 that intelligence tends to be positively correlated with desirable outcomes and negatively correlated with undesirable outcomes. This means that intelligent people generally manage to achieve good things and keep away from bad things. The size of the correlations varies a lot, however. Some correlations are around .50, while others are close to zero. These differences are quite natural given that the forms of success depicted in the table are rather different from one another. In a review of meta-analyses in psychology, Hemphill (2003) found that meta-analytic correlations tend to be somewhere between .20 to .30. Richard et al. (2003) found in a similar review that the average meta-analytic correlation in social psychology is .21. Some of the correlations with intelligence are clearly stronger than that. In particular, the correlations with education- and work-related success tend to be the stronger ones. Socioeconomic success, as measured by educational and occupational attainment, is among the strongest correlates of intelligence (see Strenze 2011, 2015, for further discussion of intelligence and various forms of success).

Table 2. Correlations between intelligence and success (results from meta-analyses).

Measure of success (or lack of success)	r	k	N	Source
Academic performance in primary education	.58	4	1791	Poropat (2009)
Educational attainment	.56	59	84828	Strenze (2007)
Job performance (supervisory rating)	.53	425	32124	Hunter & Hunter (1984)
Occupational attainment	.43	45	72290	Strenze (2007)
Job performance (work sample)	.38	36	16480	Roth et al. (2005)
Skill acquisition in work training	.38	17	6713	Colquitt et al. (2000)
Degree attainment speed in graduate school	.35	5	1700	Kuncel et al. (2004)
Group leadership success (group productivity)	.33	14		Judge et al. (2004)
Promotions received at work	.28	9	21290	Schmitt et al. (1984)
Interview success (interviewer rating)	.27	40	11317	Berry et al. (2007)
Becoming a leader in group	.25	65		Judge et al. (2004)
Academic performance in secondary education	.24	17	12606	Poropat (2009)
Academic performance in tertiary education	.23	26	17588	Poropat (2009)
Voluntary activism at workplace	.23	43	12507	Gonzales-Mule (2014)
Income	.20	31	58758	Strenze (2007)
Having anorexia nervosa	.20	16	484	Lopez et al. (2010)
Research productivity in graduate school	.19	4	314	Kuncel et al. (2004)
Participation in group activities	.18	36		Mann (1959)
Group leadership success (peer rating)	.17	64		Judge et al. (2004)
Creativity	.17	447		Kim (2005)
Self-confidence	.12	8	2219	Chang et al. (2012)
Class attendance in college	.11	4	1047	Crede et al. (2010)
Popularity among group members	.10	38		Mann (1959)
Negotiation success	.07	5	862	Sharma et al. (2013)
Happiness	.05	19	2546	DeNeve & Cooper (1998)
Procrastination (needless delay of action)	.03	14	2151	Steel (2007)
Changing jobs	.01	7	6062	Griffeth et al. (2000)
Counterproductive behavior at workplace	–.02	35	12074	Gonzales-Mule (2014)
Physical attractiveness	–.04	31	3497	Feingold (1992)
Recidivism (repeated criminal behavior)	–.07	32	21369	Gendreau et al. (1996)
Number of children	–.11	3		Lynn (1996)
Traffic accident involvement	–.12	10	1020	Arthur et al. (1991)
Conformity to persuasion	–.12	7		Rhodes & Wood (1992)
Communication anxiety	–.13	8	2548	Bourhis & Allen (1992)
Having schizophrenia	–.26	18		Woodberry et al. (2008)

r – correlation between intelligence and the measure of success, k – number of studies included in the meta-analysis, N – number of individuals included in the meta-analysis.

To make sense of the correlations in Table 2, it would be useful to have a theory that does not concentrate on just one specific form of success, but strives to explain the whole pattern of correlations. Such theories are not very abundant, but one that is quite suitable is the evolutionary theory of intelligence developed by Kanazawa (2004). According to this theory, general intelligence is a brain function that has evolved in human evolution to deal with evolutionarily novel tasks. Take, for instance, activities like finding food, having children, collaborating with other humans – these are all tasks that our ancestors have been solving for millions of years and for these tasks, it is likely, specific hereditary brain mechanisms have developed that promote the successful performance of that task. But activities like getting good grades at school, making a lot of money or being thin have just recently been invented by our society and they do not have their own brain mechanisms. For these novel tasks, people use intelligence, which is a generic ability to solve any type of (unexpected) problems. Kanazawa notes that intelligence correlates positively with evolutionarily novel activities, but the correlation with ancient activities is zero or even negative. This is also evident in Table 2, which mostly lists novel school- or job-related forms of success that have the expected positive correlation with intelligence; but one of the most ancient forms of success, number of children, has a negative correlation (–.11). A detailed discussion of Kanazawa's theory is beyond the scope of this dissertation (see Dutton, 2013, for criticism), but this theory deserves to be noted as one that tries to explain why different forms of success have different correlations with intelligence.

2.4. Intelligence and socioeconomic success

The main correlations between intelligence and socioeconomic success (education, occupation and income) were already reported in Table 2. But given that it is difficult to evaluate the importance of a predictor in isolation, let us compare the predictive power of intelligence to the predictive power of other relevant variables. Table 3 presents a selection of meta-analytic correlations between income and some of its predictors. I concentrate on income because, among the typical measures of socioeconomic success, income is arguably the most important one, and also the most thoroughly studied in meta-analyses. Intelligence is represented twice in Table 3, one correlation from the meta-analysis by Ng et al. (2005) and the other from the meta-analysis by Strenze (2007) [**II**]. The latter meta-analysis was based on general population samples, the former leaned more towards specific samples of workers from single organizations or occupational groups. The other predictors in Table 3 include parental socioeconomic status or SES (parental income, father's occupation), personality traits (extroversion, conscientiousness), educational variables (educational level, grades), and some demographic characteristics (age, gender). These are the typical "competitors" in the prediction of success. Of course,

there may be other important determinants of income but these have not been subjected to meta-analysis.

Table 3. Correlations with income (results from meta-analyses).

Predictor of income	r	k	N	Source
Educational level	.29	45	45293	Ng et al. (2005)
College grades	.28	48	9759	Roth & Clarke (1998)
Intelligence (specific samples)	.27	8	9560	Ng et al. (2005)
Age	.26	52	40197	Ng et al. (2005)
Intelligence (general samples)	.20	31	58758	Strenze (2007)
Parental income	.20	17	395562	Strenze (2007)
Father's occupation	.19	31	98812	Strenze (2007)
Gender (male vs. female)	.18	51	33211	Ng et al. (2005)
Parental SES index	.18	14	64711	Strenze (2007)
Father's education	.17	45	107312	Strenze (2007)
Mother's education	.13	37	93616	Strenze (2007)
Race (white vs. non-white)	.11	13	6443	Ng et al. (2005)
Extroversion	.10	7	6610	Ng et al. (2005)
High school grades	.09	14	41937	Strenze (2007)
Conscientiousness	.07	6	6286	Ng et al. (2005)
Locus of control	.06	7	2495	Ng et al. (2005)
Neuroticism	–.12	7	6433	Ng et al. (2005)

r – correlation between the predictor and income, k – number of studies included in the meta-analysis, N – number of individuals included in the meta-analysis.

All the correlations in Table 3 are relatively weak, the strongest one is just .29, suggesting that the financial success of people is rather difficult to predict. Intelligence is firmly among the stronger predictors of income, although the differences between some of the correlations are too small to be of much consequence. The correlations with intelligence are a bit stronger than the correlations with parental variables and significantly stronger than correlations with personality traits. Educational level is, not surprisingly, the strongest predictor. College grades are, somewhat surprisingly, much better predictors than high school grades. Overall, we can conclude that, as much as income is predictable, it can be predicted from intelligence, a bit less from parental SES and noticeably less from personality. It pays to have a good education and study well in college, but there is not much monetary incentive to doing well in high school.

As for the other measures of socioeconomic success, the meta-analysis by Strenze (2007) [**II**] also analyzed the determinants of education and occupation,

and found that these two are easier to predict than income. Correlations with intelligence are .56 and .43, respectively. Parental SES and high school grades have more or less similar correlations with education and occupation. The meta-analysis by Ng et al. (2005) also analyzed the determinants of promotions, but did not include intelligence among the determinants. All in all, it can be concluded that among the various predictors of socioeconomic success, intelligence stands out as one of the better ones.

The research on intelligence and socioeconomic success shows us that intelligent people generally occupy higher positions in society. A society with such ability-based stratification is called meritocracy (Young, 1958) and is often considered to be a desirable form of society, because people are allowed to achieve positions that corresponds to their abilities, as opposed to being allocated to positions according to their social origin (parental SES). There has been quite a lot of dispute on how meritocratic contemporary western society really is (see Kingston, 2006). In 1994 Herrnstein and Murray published a book called *The Bell Curve* that became notorious for claiming that, in the United States, intelligence has a considerably stronger effect on various forms of success than parental SES and that American society is moving towards IQ-based class system. Saunders (1997) found that the same might be true for Great Britain. Such results imply that society is rather meritocratic. However, critics have argued that these studies overestimated the importance of intelligence and underestimated the importance of parental SES (Fisher et al., 1996; Breen & Goldthorpe, 1999).

Meritocracy is an important topic for theoretical as well as practical reasons. In chapter 2.7 of this dissertation I will suggest that the level of meritocracy in society shows how efficiently the society uses the talents of its people; a more efficient allocation of talent (more meritocracy) should lead to faster economic growth.

2.5. Why intelligence predicts socioeconomic success?

Science should not stay content with just establishing a relationship between two phenomena, it should also try to explain this relationship. Therefore, having seen that there is a reasonably strong positive relationship between intelligence and socioeconomic success, we should now ask: where does this relationship come from, why intelligence predicts socioeconomic success, what is the mechanism? My experience with the literature has led me to conclude that there are three distinct explanations for the relationship between intelligence and socioeconomic success. Figure 1 presents a simple visual overview of all the three explanations.

The first one is “psychometric” explanation, which states that intelligence is a general ability to solve all sorts of problems and people who have more of this ability are more successful in their lives because they are better at solving their

everyday problems, these same people are also better at solving the tasks of an IQ test, hence the positive observed correlation between IQ scores and success – both are consequences of the underlying intelligence. There is no generally accepted word to describe this explanation, I have labeled it "psychometric" following Neisser et al. (1996). The psychometric explanation represents the original, classical view of what intelligence is and what IQ tests are supposed to measure. The supporters of this explanation are mostly psychologists and psychometricians, some of them are involved in the construction of tests (e.g., Herrnstein & Murray, 1994; Jensen, 1998; Gottfredson, 2003; Schmidt & Hunter, 2004).

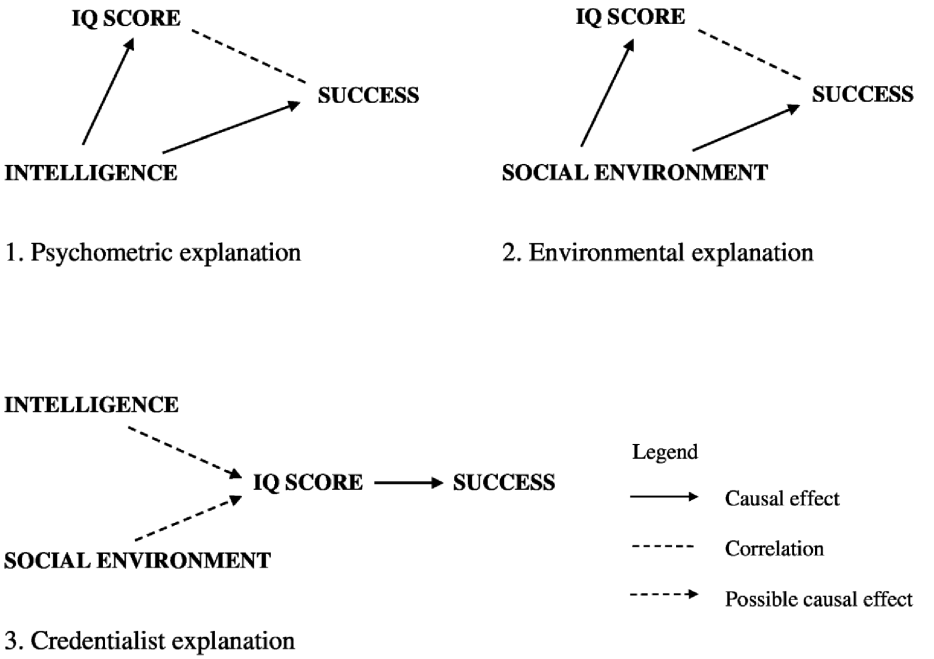

Figure 1. Three explanations of the relationship between IQ scores and success.

The second explanation is called "environmental" and according to that, social environment is the real cause of success, people who come from good environment are more successful because they have all sorts of social advantages, these same people are also better at solving the tasks of an IQ test, hence the positive observed correlation between IQ scores and success – both are consequences of the social environment. Environment is a vague concept, of course, but mostly it is specified as social origin or parental socioeconomic status (SES); the idea being that children of wealthy and educated parents have the necessary resources to be successful in life as well as in IQ tests. Intelligence as a stable characteristic of people has no role in this explanation or only a marginal role.

The supporters of this explanation tend to be sociologists and sociologically minded psychologists (e.g., McClelland, 1973; Bowles & Gintis, 1976; Fischer et al., 1996).

The third explanation is a bit more specific and less known, I call it "credentialist" because of its affinity to the theory of educational credentials (see Brown, 2001). In this explanation, it is the IQ score itself that directly causes success; it does not matter much if IQ score measures intelligence or social environment, what matters is that people are given IQ tests and are assigned to social positions (admitted to colleges, hired to jobs) on the basis of their IQ scores; people with higher scores, of course, get better positions. If such IQ-based assignment takes place in a large enough scale, then it could shape the social structure and create a society-wide positive correlation between IQ scores and success. Several authors believe that this is what is happening in the United States and, possibly, in other western societies (see Block & Dworkin, 1976; Lemann, 1997; Byington & Phelps, 2010).

As we evaluate the mechanisms presented in the three explanations of Figure 1, it is evident that the first mechanism (psychometric) is the only one that presents intelligence as the real cause of socioeconomic success – this is the only one where people with high IQ scores achieve success because of their superior mental abilities. In the environmental mechanism, the correlation between IQ scores and success is spurious, social environment is the real cause; the researchers who lean towards this explanation often doubt the existence of intelligence as a stable mental characteristic of people (see Table 1). The credentialist mechanism does not necessarily deny that intelligence causes success, but the causation takes place in a "wrong manner". A lot depends on whether IQ scores represent real intelligence or social environment – if IQ scores represent intelligence, then the IQ score-based assignment of people would simply accelerate the natural process of intelligent people ending up in superior positions; if however, IQ scores represent environment, then it would mean that any IQ score-based assignment is arbitrary and does not have the alleged effect of sorting people according to their real ability.

So what evidence would allow us to say which explanation is the best one? The most general kind of evidence can be obtained by just comparing the correlations of intelligence and parental SES with socioeconomic success. We saw in Table 3 that both intelligence and parental SES have positive correlations with income; Strenze (2007) [**II**] showed that both have positive correlations with education and occupation, as well. Neither intelligence nor parental SES seems to be an overwhelmingly stronger predictor of socio-economic success, although there is a slight tendency for intelligence to be a better predictor in several instances (see Strenze, 2007 [**II**], for further discussion). This finding can be interpreted as showing that the environmental explanation cannot be hundred percent correct, the correlation between IQ scores and socioeconomic success cannot be completely explained by parental SES – if this were the case, then parental SES should have stronger correlations

with success but, as we saw, this is not the case. Therefore, the effect of intelligence must be, to some degree, independent from the effect of parental SES.

That last conclusion has been confirmed in much greater detail by the studies of status attainment. These studies have used sophisticated regression and path models to analyze the determinants educational, occupational and income attainment. Many of these studies have included intelligence among the determinants, making it possible to see if intelligence affects attainment after controlling for a number of alternative determinants. The typical result has been that intelligence remains a significant predictor even after controlling for parental education, occupation and income (Jencks, 1979; Sewell et al., 1980, Herrnstein & Murray, 1994; Fischer et al., 1996; Saunders, 1997), absence of one parent (Jencks, 1979; Sewell et al. 1980), number of siblings (Jencks, 1979; Blake, 1989), parents' educational support for the child (Jencks, 1979; Otto & Haller, 1979; Sewell et al., 1980; Bond & Saunders, 1999), ethnicity or race (Jencks, 1979; Strenze, 2006 [**I**]). Thus, the influence of intelligence cannot be explained away by many of the important environmental variables. On the other hand, most studies show that the effect of environmental variables on success also remains statistically significant after controlling for intelligence. A reasonable conclusion is that both intelligence and environment have independent effects on socioeconomic success. In terms of theoretical mechanisms (of Figure 1) it means that both psychometric and environmental mechanisms are at work.

Such "battle of coefficients" supplies us with important information but it cannot tell us, what is the ultimate source of the intelligence-success relationship – genes or environment. The intersection of genetics, intelligence and success is a complicated subject full of different methods and contradictory findings (see Gottfredson, 2011, for a review). On the one hand, it is long known that intelligence is substantially heritable (determined by genes; Devlin et al., 1997), more recently it has become known that socioeconomic success is also heritable (Plomin & Bergeman, 1991; Rowe et al., 1999). These results seem to imply that the "genetic intelligence" is an important cause of socioeconomic success. Indeed, Rowe et al. were able to determine that both intelligence and socioeconomic success are influenced by the same genes. Thus, the "genes for intelligence" are also the "genes for success". On the other hand, using different methods, Bowles and Gintis (2002) have shown that the role of "genetic intelligence" in the status attainment process has been greatly overestimated. They do not deny that socioeconomic success is heritable, but they claim that it is so mostly due to other genetic characteristics, like race, health or personality. The present dissertation cannot pass a final judgement on this topic but it must be remembered that the question of genetics looms behind every study of intelligence, even if the question is not addressed explicitly.

What about the credentialist explanation to the relationship between intelligence and socioeconomic success? There has been a lot of dispute in the United

States over the use of IQ tests in educational and employment setting. In educational setting, psychological tests (including IQ tests) are often used for admitting students into schools and placing them into tracks within schools (Byington & Phelps, 2010). The use of IQ tests for track placement has actually diminished since the 1970s (Loveless, 1998), but admission into colleges is still largely based on SAT and ACT tests, which are both strongly correlated with traditional IQ tests (Frey & Detterman, 2004; Koenig et al., 2008). In employment setting, psychological tests (including IQ tests) are mostly used for selecting new employees, but sometimes also for promoting existing employees (Wigdor & Garner, 1982, chapter 4). IQ-based personnel selection has been under heavy criticism in the United States since the 1960s and has, consequently, declined (Hunter & Schmidt, 1996). In some other countries, however, ability tests are used quite frequently (Ryan, et al., 1999). Based on these facts, it seems only natural to assume that IQ testing could have a considerable effect on what happens to people during their educational and occupational career.

Direct empirical research on this assumption is unfortunately very scarce. Only one published study has conducted an explicit statistical analysis of the idea that the use of IQ tests has an effect on the relationship between intelligence and success. This is the study by Tittle and Rotolo (2000) that attempted to find out if the correlation between IQ scores and income (or occupation) in U.S. states depends on the amount of standardized personnel testing that goes on in the states. And indeed, they found that the correlation is stronger in the states where personnel testing is more prevalent. Another, unpublished, study asked if the correlation between IQ scores and income is stronger among individuals who have been tested for IQ in their current occupation? The correlation was slightly stronger among tested individuals but not significantly so (Strenze, n.d.). Both of these studies, thus, found that the relationship between intelligence and socioeconomic success is somewhat stronger among individuals who have been tested for IQ as part of their employment, suggesting that IQ testing has boosted the positive relationship between IQ scores and socioeconomic success. However, both studies had several problems with the data, so it is too early to say how much personnel testing explains the correlation between intelligence and socioeconomic success.

Based on this review, we can conclude that all the three explanations have some supporting empirical evidence under their belt. In other words, the overall positive relationship between intelligence and socioeconomic success probably owes something to all three mechanisms. But that does not mean that all three mechanisms are equally important all the time. It is possible that different mechanisms "dominate" different parts of the status attainment process.

Take, for instance, the relationship between intelligence and college education. Majority of college students are accepted into college (at least partly) on the basis of various college admission tests (SAT and ACT tests in USA, state examinations in Estonia); these admission tests are not officially labeled as IQ

tests but they are known to be positively correlated to traditional IQ tests (Tina, 2002; Frey & Detterman, 2004); the usage of such admission tests is bound to create a positive correlation between intelligence and getting into college – this correlation is the work of the credentialist mechanism. Of course, achieving a college education entails more than just getting into a college – you also have to study in college – but at the specific moment of getting admission into college, the credentialist mechanism takes precedence over other mechanisms.

As another example, let us consider the role of intelligence during different life periods of people. There has been a lot of dispute over what IQ tests really measure – is it the stable mental ability inside a person or the social environment around a person (see chapter 2.1)? An interesting possibility is that IQ tests actually measure somewhat different things for people of different ages. Studies have shown that the heritability of IQ scores gets stronger as people grow older (Briley & Tucker-Drob, 2013); this means that IQ tests measure mostly genetically determined ability among older people and mostly environmental influences among younger people. Studies have also shown that IQ scores become more stable as people grow older (Schuerger & Witt, 1989); this means that IQ tests measure a rather stable ability among older people and a more fluctuating ability among younger people. In addition to that, studies have shown that the relationship between children's IQ scores and parental SES grows weaker as children grow older (Kall, 2010); this means that IQ scores are more dependent on social influences among younger people than among older people. To these results, let us add the finding that the effect of intelligence on career success (occupation and income) gets stronger as people grow older (Strenze, 2007) [**II**], the effect of parental SES on career success, however, gets weaker as people grow older (Ganzach, 2011).

A possible interpretation of all these results is that the relationship between intelligence and socioeconomic success is better explained by the environmental mechanism among younger people – because their IQ scores are mostly a reflection of the environment and the relationship between their IQ scores and success is not that strong. Among older people, however, the relationship is better explained by the psychometric mechanism – because their IQ scores are mostly a reflection of stable ability and the relationship between their IQ scores and success is quite strong. In very simple terms, young intelligent people owe their success mostly to their privileged social background, older intelligent people owe their success mostly to their superior mental capacities. This statement is a simplification, of course, and it should be taken as a hypothesis, not a final conclusion.

Such age related changes provide interesting examples of how different mechanisms can switch on and off during life course. That is why it is unlikely that any of the three mechanisms in Figure 1 can provide a total explanation for the relationship between intelligence and socioeconomic success – that relationship is the result of all three mechanisms working at different times and in different situations.

2.6. Intelligence and socioeconomic success in different societies

The evidence for the relationship between intelligence and socioeconomic success comes almost exclusively from contemporary western societies (Strenze, 2007) [**II**]. But what about earlier historical periods and less developed societies? Do these societies also have intelligent people on top? This question is important for explaining the relationship between intelligence and socioeconomic success – if there are systematic differences between societies in terms of the relationship, then it would mean that societal context has to be taken into account to provide a full explanation of the relationship.

There is, of course, no direct evidence from earlier than the 20th century because IQ tests had not been invented yet. But the general opinion seems to be that earlier historical periods mostly did not allow intelligent people to get ahead in society. These societies presumably had rigid class systems and a person born to lower ranks had no opportunity to rise to upper ranks, no matter how intelligent he or she was. According to *The Bell Curve* (Herrnstein & Murray, 1994), western societies started to become more meritocratic only in the middle of the 20th century. Around that time, the educational system became more democratic and universities were opened up to intelligent youth from all social backgrounds. At the same time, the occupational system became more complex with a lot of new cognitively demanding jobs requiring intelligent workers. These two historical developments – increasing openness and complexity – are the main social factors that created the positive correlation between intelligence and socioeconomic success, according to Herrnstein and Murray (1994).

This scenario sounds convincing but it has been criticized on several grounds. First, there is reason to believe that intelligent people were, in fact, able to achieve some success in earlier historical periods. Such as the 19th century French army officers who were recruited and promoted on the basis of their talent, rather than social background (Botton, 2004). Or the young men from modest social background who were able to work themselves into higher positions in the 16–17th century Germany (Weiss, 1995). These are probable examples of the positive correlation between intelligence and socioeconomic success in earlier historical periods (see Strenze, 2015, for a longer discussion). Second, the supposed strengthening of the intelligence-success relationship during the 20th century has been questioned. A number of studies have tried to test this claim and most have failed to find the strengthening of the IQ-success correlation, predicted by *The Bell Curve* (Hauser & Huang, 1997; Bowles et al., 2001; Strenze, 2007 [**II**]). All these studies have used data collected over several decades (mostly starting with the 1960s) and they have not found any signs of the IQ-success relationship getting stronger during that time.

An alternative way to address the same issue is to compare data from different countries to see if less developed countries have a weaker relationship

between intelligence and socioeconomic success – that would support the idea that societies become more meritocratic as they evolve from traditional into industrial and postindustrial. Research on intelligence and success in the developing world is not very abundant. In their review, Hanushek and Woessmann (2008) found about 10 studies on the relationship between cognitive skills and wages, conducted mostly in African countries. They concluded that "*the returns to cognitive skills may be even larger in developing countries than in developed countries*" (p. 621). However, the results of these studies are somewhat difficult to compare to each other and to the results from developed countries, because each study used its own analytical tools. Also, it is not clear how much the measures of "cognitive skill" in these studies correspond to standard measures of intelligence.

A better way to compare societies is to use a single cross-national data set that includes the same measures for all participating countries. A conclusive cross-national analysis of the relationship between intelligence and socioeconomic success is yet to be conducted. But as a preliminary gauge, take a look at Figure 2 that presents a simple scatterplot based on data from Programme for the International Assessment of Adult Competencies (PIAAC). PIAAC is a cross-national survey, conducted in 2012, that measured the numeracy and literacy ability of adults in 22 countries; it also included data on the career success of these adults. Hanushek et al. (2013) calculated for each country the effect (regression coefficient) of numeracy ability on income, controlling for gender and work experience – that effect is presented on the vertical axis of Figure 2. The horizontal axis of Figure 2 is the 2011 per capita Gross National Income (GNI), a measure of economic development taken from the World Bank database. Based on the reasoning offered above, one would expect to find a positive relationship between GNI and ability-income correlation, but in fact the relationship in Figure 2 is not that clear. Some of the more developed countries with higher GNI, like Norway or Sweden, tend to exhibit the lowest correlations between people's ability and income, while the less developed countries like Poland and Spain have stronger correlations. A remarkable exception is USA that has one of the highest GNI and also the strongest relationship between ability and income – this suggests that USA might be the model case of a society where economic development has resulted in strong meritocracy.

Of course, the data used in Figure 2 is far from perfect as the number of countries is too small to draw any ironclad conclusions and the sample of countries is not representative of the entire spectrum of economic development. Also, the ability tests of PIAAC are not really tests of "intelligence" in the strict sense. All these considerations force us to be careful when interpreting Figure 2. However, a more representative cross-national analysis was conducted by Psacharopoulos and Patrinos (2004) as they compared the relationship between education and income in nearly 100 countries and found that the relationship is stronger in less developed countries. That supports the impression that, among

the societies that exist today, less developed societies tend to be the ones where people with higher ability (and education) get better financial rewards.

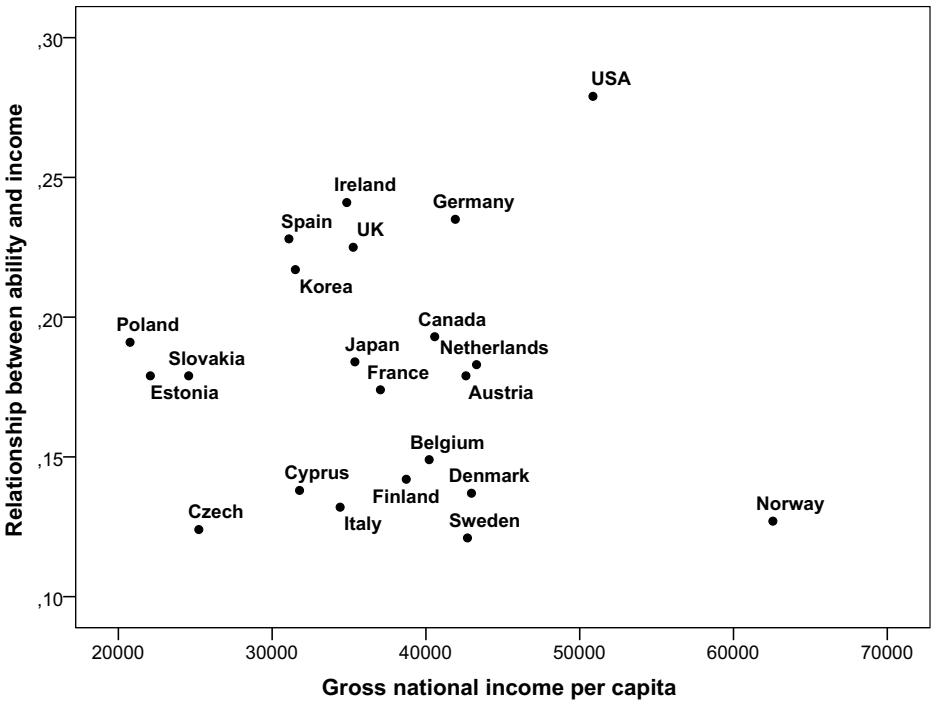

Figure 2. Intelligence-success relationship in the country (vertical axis) and economic development of the country (horizontal axis).

Based on the evidence presented in this chapter, we can conclude that the relationship between intelligence and socioeconomic success is indeed dependent on the societal context. But that dependence might not be quite the way it was imagined by the authors of *The Bell Curve*. It is difficult to say anything conclusive about earlier centuries, but in the 20th and 21st century there seems to be no clear trend of the intelligence-success relationship getting stronger as societies become more developed. Indeed it seems that the opposite is true: the relationship is weaker in more developed societies and stronger in less developed societies. If asked for an explanation, one could speculate that there is an intense competition for scarce resources in the less developed societies, which gives rise to a "survival of the intelligent" effect, while in the more developed societies most people have access to resources.

2.7. Allocation of talent in different societies

The present discussion on intelligence and success has so far stayed on the individual level; it has been about the intelligence of individuals and the consequences of that intelligence for these individuals. In recent decades, however, a new research tradition has emerged that studies intelligence on the macro or collective level. This research typically takes the results of individual-level ability testing and uses the average test score of individuals as a macro-level variable. This average IQ is then used in macro-level analysis along with other macro-level variables. Among psychologists this approach has recently become known through the work of Lynn and Vanhanen (2002, 2006). They have found that the average IQ scores of people living in different countries (national IQs) are strongly and positively correlated with the level of economic development among these countries. In economics, a similar result has been obtained in the studies of economic growth: the average scores on tests of academic achievement (such as PISA or TIMSS test) are strongly and positively related to the rate of economic growth of the countries (Hanushek & Kimko, 2000; Hanushek & Woessmann, 2008). Studies of smaller collectives have shown that work teams that are composed of more intelligent members are better at performing the work tasks (Devine & Philips, 2001). This research is not without critics (e.g., Volken, 2003) but, nevertheless, it complements the individual-level research by showing that intelligence can create inequality not just between people but also between societies or groups.

This macro-level paradigm has mostly focused on the average ability of people as a determinant of macro-level success. But there is another way to approach the issue: instead of the *average* level of ability, one can look at the *allocation* of ability in society. Given that people are not all equal in their abilities and talents, one can ask: how do societies allocate (distribute) people with different abilities? The central hypothesis would be: societies that allocate people more efficiently are more successful. Thus, even if two societies are equal in terms of the average level of ability, one can still outdo the other if it has a better allocation of talent (Murphy et al., 1991).

The basic idea behind the problem of allocation of talent is that society is composed of people who differ in terms of their abilities (talents) and other characteristics (such as personality traits). These people have to be allocated in society between different tasks (by "task" we mostly mean job or occupation). The allocation is efficient or beneficial if there is a good match between people and jobs. The good match can be understood in various ways depending on which characteristics of people and jobs we have in mind. Table 4 provides a preliminary framework for thinking about matching people to jobs. The table lists some important variables that differentiate people (intelligence, personality) and jobs (complexity, productivity). Within the cells of the table, I have written simple suggestions as to what would constitute a good match of people

and jobs in terms of these variables. The suggestions are derived from the research discussed below.

Table 4. Some examples of the ideal allocation of people to jobs.

	Intelligence of people	**Personality of people**
Complexity of jobs	Complex jobs should be filled with intelligent workers, because they are less likely to fail when performing these complex tasks. The less job-related failure there is, the better for the society.	Complex jobs should be filled with mentally stable workers, because they are less likely to fail under the pressure of these jobs. The less job-related failure there is, the better for the society.
Productivity of jobs	Productive jobs should be filled with intelligent workers, because they are more likely to perform well. It is important to perform well in productive jobs, because these jobs contribute more to society.	Productive jobs should be filled with hard working workers, because they are likely to work harder. It is important to work hard in productive jobs, because these jobs contribute more to society.

The idea that a good fit between people and tasks is beneficial for society dates back to Ancient Greek (see Plato, 2000: 127). In more recent times, the idea was picked up by the sociologists of the functionalist tradition who theorized that a match between people's talents and their social positions is necessary for the effective functioning of society (see Davis & Moore, 1945). Currently, the idea lives on in psychology and economics. But unfortunately, most of the discussion is theoretical and very little empirical research has been conducted on this subject.

In psychology, there has been some interest in the correspondence between people's intelligence and cognitive complexity of their jobs. There is substantial evidence that different jobs and occupations can be reliably distinguished in terms of the type and level of ability required to perform the job tasks (Campbell, 1988; Gottfredson, 1986a, 1986b). For instance, engineer and dentist are cognitively complex jobs, dishwasher and weaver are not so complex (Roos & Treiman, 1980). The idea is that more intelligent people should be allocated to more complex jobs and less intelligent people to less complex jobs. That should improve the overall output of the national economy (Gottfredson, 1986a). How to allocate people to jobs that suit their abilities? Hunter and Schmidt have argued that it can be achieved through mental testing – if most organizations in the society used IQ tests for selecting their employees, the overall allocation of talent in the society would increase dramatically and that could, in turn, boost the national economy (Hunter, 1983; Hunter & Schmidt, 1982, 1996). The only empirical test of this theory is the study by Strenze (2013) [**III**]. It found that economic growth is indeed a little faster in the countries with a stronger

association between intelligence and job complexity, and with more frequent ability testing in personnel selection. However, the data used in this study were far from ideal and the effects were rather weak. A proper confirmation of this theory awaits future studies.

In economics, the approach to allocation of talent has been somewhat different as economists have been interested in the productivity of occupations (rather than complexity). At heart of the economic approach is the idea that some occupations are, by their very nature, more productive (useful) than others; for instance, engineering and entrepreneurship have been described as productive activities, law and religion as unproductive ones. Talented people should be directed to productive occupations; the more society is able to do that, the better off it will be in economic terms (Murphy et al., 1991; Galor & Tsiddon, 1997; Hassler & Mora, 2000). The major problem with the economic approach is the lack of clarity about the measurement of the productivity of occupations. There is no numerical scale of occupational productivity (as there is for occupational complexity, see Roos & Treiman, 1980), so there is no objective basis for telling which occupations are the most productive. Allocation of talent in relation to productivity cannot be systematically analyzed until this problem has been overcome.

Now it is time to ask: how is the topic of allocation of talent related to the topic of intelligence and socioeconomic success? I hope the reader has already guessed the answer – the relationship between intelligence and socioeconomic success *is* a measure of allocation of talent; the stronger the positive relationship between intelligence and socioeconomic success in society, the better the allocation of talent. It is possible to claim so because of the strong correlation between socioeconomic success and occupational complexity. Studies of occupational complexity have found that the cognitive complexity of jobs is positively correlated with the variables that are typically used to measure socioeconomic success. Spaeth (1979) reported a correlation of .74 between occupational complexity and occupational prestige, and a correlation of .81 between occupational complexity and occupational authority in the United States. Menes (2008) reported correlations around .80 between the technological complexity of occupations and prestige or typical wages of occupations. Wilk and Sackett (1996) reported a correlation of .70 between the cognitive complexity and typical wages of occupations. Using people (not occupations) as units of analysis, Ganzach (2003) found that the complexity of people's occupation correlates around .50 with their education and around .30 with their salary. Therefore, if intelligent people have achieved more success in terms of education, occupation or salary, then they are likely to be working in more complex jobs, which means that their superior intelligence is put to good use. A strong and positive correlation between intelligence and socioeconomic success is, thus, good for the society because it should foster economic growth.

That puts the relationship between intelligence and socioeconomic success into a new light. That relationship is not just a "thing in itself", a result of past

societal processes that has no further implications. On the contrary, that relationship is possibly an important influence on future societal development. The size of that relationship could be used as an indicator of the economic potential of society. If so, governments should be interested in measuring that relationship in their country and take steps to increase the relationship if necessary. In chapter 2.6 we saw that contemporary societies differ in terms of the strength of the relationship between ability and income, the relationship tends to be stronger in less developed societies (see also Strenze, 2015). This could be taken as a warning sign for some the most affluent societies implying that these societies have perhaps become complacent with the achieved level of well-being and are not using their intellectual resources to the fullest extent. For some of the less developed societies this could be taken as a promise of future growth.

3. OVERVIEW OF THE ORIGINAL STUDIES

This chapter of the dissertation provides an overview of the original studies that form the basis of the dissertation. In fact, results from the original studies have already been cited numerous times in the preceding text but now the studies will be described in more detail.

3.1. Aims of the original studies

Study **I** (Strenze, 2006) is a rather simple and straightforward study that follows the tradition of sociological status attainment research (e.g., Jencks, 1979). It analyzed intelligence and parental socioeconomic status (SES) as predictors of education, occupation and income in Estonia and the United States. The main reason for conducting this study was to investigate the relationship between intelligence and socioeconomic success in Estonia – no study had done that before. The study set out to show that intelligence is a significant predictor of socioeconomic success in Estonia, as it is known to be in other western societies. The predictive power of intelligence was compared to that of parental SES to determine which one has a stronger effect on success. To provide international context, the study included the analysis of the same relationships in USA.

Study **II** (Strenze, 2007) is a meta-analysis of the relationship between intelligence and socioeconomic success. The starting point for the study was the observation that quite a lot of research had investigated intelligence as a predictor of education, occupation or income, but so far very few attempts had been made to systematically review that research. That seemed like a good reason to apply the method of meta-analysis, which means collecting the results of the original studies and providing a quantitative summary of these results (see Hunter & Schmidt, 2004). Thus, the study set out to provide a comprehensive meta-analysis of the longitudinal research on the relationship between intelligence and socioeconomic success. The meta-analysis was limited to longitudinal research (where intelligence of people is measured before their success) because only longitudinal design allows one to make conclusions about the possible causal effect of intelligence on success. Given that is difficult to evaluate the importance of a predictor in isolation, the study also included the meta-analysis of parental SES and academic performance (school grades) as predictors of socioeconomic success to see if intelligence is a better predictor of success than the other variables.

Study **III** (Strenze, 2013) is a cross-national analysis of the economic growth of countries. The study was based on the idea that the economic success (growth) of a society should depend on how well it utilizes the mental abilities of its people. This is what economists call the “allocation of talent”. There has been quite a lot of theoretical discussion about this idea but virtually no

empirical research. This study set out to clarify the concept of allocation of talent, construct some indicators of allocation of talent for countries and analyze the relationship between these indicators and the economic growth of countries. Because there was not much data available for countries, the study also included the analysis of the economic growth of U.S. states to see if the same relationships exist both at the country and state level.

3.2. Data and methods of the original studies

Study **I** used longitudinal data from Estonia and the United States. The Estonian data set is called Paths of a Generation, which is a longitudinal survey started in 1983 with a sample of young people aged about 17 (see Titma, 1999). As part of the first round of data collection, the respondents were given an IQ test. That makes it the only data set in Estonia that offers an opportunity to study the long term effects of intelligence on later life course. In USA there are several longitudinal data sets to choose from, I used the National Longitudinal Survey of Youth because of its similarity to the Estonian data set in terms of age of the sample and timing of the first round. For data analysis I used simple descriptive statistics and regression analysis.

Study **II** used common meta-analytic methods (see Hunter & Schmidt, 2004). In order to conduct a meta-analysis of the relationship between intelligence and socioeconomic success, the first step was to assemble a database of the results from original studies. I used correlation coefficient as the measure of the relationship, therefore, I collected as many correlations as possible from various articles and books. The correlations I looked for were between intelligence and measures of socioeconomic success (education, occupation and income), between measures of parental SES (father's and mother's education, father's occupation, parental income, SES index) and socioeconomic success, and between academic performance and socioeconomic success. In some cases I obtained the raw data and calculated the necessary correlations myself, if the data had not been used in any publication. The correlations were weighted with sample size and corrected for unreliability. The analysis of the correlations proceeded in two steps. First, the overall summary of the strength of the relationship between predictors and socioeconomic success. Second, a moderator analysis of the correlations between intelligence and socioeconomic success to determine if the strength of the correlations depended on sample characteristics (e.g., age of the sample or year of data collection).

Study **III** used macro-level data to analyze allocation of talent as a determinant of economic growth of countries and U.S. states. The first step of the analysis was constructing the indicators of allocation of talent for countries and states. The different indicators were based on ideas developed in psychology and economics; and various sources of data were used for their construction. Some of the indicators were calculated from individual-level data for

countries or states (the International Adult Literacy Survey data set or the U.S. census public use data), some were obtained from international data sets (the Occupational Wages Around the World data set), some were obtained from published sources. Data for the economic growth came from Penn World Tables and U.S. Bureau of Economic Analysis. The statistical analysis of the determinants of economic growth was done in the tradition of "growth regression", which is a regression analysis that attempts to predict the economic growth rate (see Barro & Sala-I-Martin, 1995).

3.3. Results of the original studies

Study **I** found that intelligence has a positive effect on educational, occupational and income attainment in Estonia. However, comparison with the United States showed that the effect of intelligence is somewhat weaker in Estonia (compared to USA); parental SES has a more or less equal effect in both countries. From that the study concluded that "*Estonian society is less open and meritocratic than American society*" (p. 232). A possible reason for this could be the relative instability of the Estonian society in the 1990s (the time the data on socio-economic success were collected). It was initially hypothesized that the harsh and unstable social environment of Estonia could increase the importance of intelligence, but actually the opposite seemed to be the case – the stable and open American society apparently creates better conditions for intelligent people to realize their potential in the labor market. This interpretation contradicts the observations presented in chapter 2.6 about intelligence being less important for success in the most developed societies. But let us remember that the analysis in study **I** compared just two societies, it is difficult to draw firm conclusions about why the societies differ from so few societies.

The meta-analysis in study **II** found that intelligence is positively correlated with later education, occupation and income; the average corrected correlations are .56, .43 and .20, respectively. The existence of the positive correlation between intelligence and socioeconomic success is in no way surprising, but things get more interesting if we compare these correlations with other correlations and do moderator analysis. The meta-analysis also found positive correlations between parental SES and academic performance with socio-economic success; these correlations range from .09 to .50. Thus, the study showed that intelligence is at least as good a predictor of success as are parental SES and academic performance, and perhaps even a bit better. The theoretical significance of this result was already explained in chapter 2.5 – it shows that the correlation between intelligence and socioeconomic success cannot be completely explained by parental SES or academic performance; therefore, the effect of intelligence on success must be, to some degree, independent from the effect of social environment.

Moderator analysis in study **II** also uncovered some interesting patterns. It found that the correlation of intelligence with occupation and income becomes stronger as people get older. This result supports the so called "gravitational hypothesis", which states that the impact of intelligence on people's career becomes stronger with aging as people "gravitate" to social positions that correspond to their intelligence. However, the gravitational hypothesis does not work in educational attainment – the effect of intelligence on education grows a bit weaker after early twenties, indicating that most people achieve their "right" level of education rather quickly and later there is some readjustment as less intelligent people catch up in terms of educational qualifications. The meta-analysis also investigated the historical changes in the correlation between intelligence and socioeconomic success, but no clear pattern was found. Thus, the study offered no support for the claim that intelligence has recently become more important as a determinant of status attainment.

Study **III** found that the countries and states that have a better allocation of talent exhibit somewhat faster rates of economic growth. This result supports the idea that allocation of talent is one of the determinants of the wealth of nations. However, it must be noted that the study had several methodological problems, the most noticeable of them being small sample size in some of the analyses. Thus, the empirical results of the study can, at best, be taken as a first indication that allocation of talent could be important for the economy, no firm conclusions can be drawn about it right now. Another empirical matter that the study dealt with was the measurement of allocation of talent. Four distinct indicators of allocation were constructed for the study – relationship between ability and job complexity in a country, prevalence of ability testing in a country, monetary returns to education in a country, and monetary rewards in complex occupations in a country. It is of some interest that all the indicators were positively correlated with one another, indicating that a common underlying construct was being measured. This result offers some cause for optimism about the construct of allocation of talent as a "real" social phenomenon.

3.4. Original contributions of the original studies

In this section I will briefly describe what I believe to be the original contributions of the original studies to scientific progress. Study **I** was rather modest in this regard, it did not offer much originality in terms of theory development or novel research questions. The most original thing in this study was the analysis of Estonian data – no previous study had analyzed the relationship between intelligence and socioeconomic success in Estonia – the theoretical and methodological background of the analysis was the same as in numerous previous studies (e.g., Jencks, 1979). Still, such low key research should not be underestimated as it is the foundation of scientific knowledge.

Study **II** aimed at covering more ground by offering a systematic review of the research on intelligence and socioeconomic success. This study is arguably the most extensive analysis that has ever been conducted on this topic. The empirical results of the study were presented as conclusive answers to questions that had been studied for decades by social scientists in various countries (e.g., which is a better predictor of socioeconomic success, intelligence or parental SES; does the relationship between intelligence and socioeconomic success change with age and historical time?). Whether or not the answers remain "final" is another matter – it is entirely possible that future empirical studies might challenge the conclusions of the study.

Study **III** was, perhaps, the most original of the three in terms of offering novel ideas. Through the analysis of theories from various fields, the study developed an approach to thinking about the relationship between individual talents and societal development; at the center of the approach is the idea that societal development depends on how individuals with different talents are allocated (distributed) in society. The idea itself has been discussed by other authors, but this study brought the idea closer to empirical investigation than most previous studies. The empirical section of the study was somewhat lagging, however, because of lack of suitable data, so the main contribution of the study was asking new questions, rather than offering answers.

4. CONCLUSIONS

The general aim of this dissertation is to contribute to the scientific knowledge on the relationship between intelligence and socioeconomic success. More specifically, the dissertation had three goals: describe the relationship, analyze its causes and its social consequences. Now it is time to present conclusions about these three goals. The short version of the conclusions is the following: the relationship between intelligence and socioeconomic success is strong, it has multiple underlying causes and it affects the economic growth of society. But let us take a closer look at the conclusions one by one.

4.1. Relationship between intelligence and socioeconomic success

The first goal of the dissertation was to describe the relationship between intelligence and socioeconomic success. It is clear that intelligence is positively related to socioeconomic success, as well as to various other forms of success (see chapters 2.3 and 2.4). The correlation between intelligence and socioeconomic success is strong, when compared to correlations with other forms of success (see Table 2) and to correlations with other predictors of socioeconomic success (see Table 3). In other words, intelligence predicts socioeconomic success better than most other forms of success and among the known predictors of socioeconomic success intelligence is one of the strongest.

The existence of a positive correlation between intelligence and success is hardly surprising. What the present dissertation adds to this knowledge is the comparison of various forms of success and predictors. Such comparisons (as in Table 2 and 3) allow us to get a general understanding of the pattern of relationships between variables of interest. This understanding could come in handy when developing a theory of intelligence (e.g., Kanazawa, 2004). Indeed, one useful avenue of future research is to extend the review of the correlates of intelligence. That is, to assemble and compare correlations between intelligence and relevant variables. The relevant variables might include psychological characteristics (e.g., personality traits), possible determinants of intelligence (e.g., parental SES), possible behavioral outcomes (e.g., religiosity).

Of course, the mere knowledge of an empirical relationship is not enough. We have to put it into a wider theoretical context. In this regard, it is important to realize that the question about the relationship between intelligence and socioeconomic success is intimately tied to other scientific questions about intelligence (see Table 1). Questions like: does intelligence really exist, what IQ tests really measure, etc.? A researcher who does not believe that IQ tests measure general mental ability would have a very different interpretation of the correlation between IQ scores and success, compared to the researcher who does believe in the validity of IQ tests. This is why the study of the relationship of intelligence and success cannot be isolated from other topics of the IQ debate.

4.2. Causes of the relationship

The second goal was to analyze the causes of the relationship between intelligence and socioeconomic success. While the existence of the relationship between intelligence and socioeconomic success has rarely been questioned, the mechanism of that relationship remains a contested issue. Chapter 2.5 discussed three possible explanations for the relationship: the first explanation states that intelligent people are successful thanks to their intelligence, the second explanation states that intelligent people typically come from privileged social background and this is the reason for their success, the third explanation states that intelligent people are rewarded for their IQ test scores. No firm conclusion could be drawn as to which explanation is the correct one. Indeed, such a conclusion will likely never be drawn because there is empirical evidence to support all the three explanations. A possible solution to this situation is the hypothesis that the three explanations apply to different parts of the status attainment process (see chapter 2.5).

Only one of the explanations (the psychometric explanation, see Figure 1) views intelligence as the actual cause of socioeconomic success; in other explanations, intelligence is not the actual cause, but merely correlated to the actual cause. It is of some interest that the causal explanation is quite successful in accounting for the correlation between intelligence and success in work and educational contexts. This means that the effect of intelligence on socio-economic success is, to a considerable extent, causal (non-spurious, not explained by third variables). Therefore, even if intelligence is not the underlying cause of *all* the success and failure that people experience, quite a large part of it can still be attributed to intelligence.

An additional conclusion about the causes of the relationship between intelligence and socioeconomic success is that the analysis of these causes should also take account of the societal context (see chapter 2.6) – the relationship between intelligence and socioeconomic success is somewhat different in different societies because society can either facilitate or hinder the relationship. Further cross-national studies of the relationship between intelligence and socioeconomic success are needed to fully understand how societal context affects the relationship. Studies from developing, non-western countries would be especially valuable because most of the research has so far been conducted in rich western countries.

4.3. Social consequences of the relationship

The third goal was to analyze the social consequences of the relationship between intelligence and socioeconomic success. The positive individual-level relationship between intelligence and socioeconomic success has important consequences for the economic growth of society; societies with a stronger

relationship grow faster because of better allocation of talent (see chapter 2.7). Societies with good allocation of talent have assigned intelligent people to cognitively complex jobs and less intelligent people to simple jobs. Such division of labor assures that the talent of intelligent people does not go "wasted" in simple jobs and the lower ability of less intelligent people does not jeopardize the execution of complex jobs. These are, however, preliminary ideas and more research is needed to confirm these findings and understand their theoretical and practical implications.

Allocation of talent is still a relatively new research topic. Sociological theory could use it as a mechanism to connect the characteristics of people to the functioning of society, a topic that has fascinated social theorists for a long time (see Alexander et al., 1987). This dissertation was more interested in the empirical analysis of allocation of talent. However, the empirical research is hindered by lack of suitable data. Hopefully, this situation improves in the future as better data become available.

The conclusion about the economic benefits of allocation of talent is the most practical conclusion of this dissertation. If confirmed, it would mean that the relationship between intelligence and socioeconomic success could be used as a social indicator of the allocation of talent. Governments might want to measure this relationship regularly and take steps to increase it. Also, it should make it quite rewarding for social scientists to study the relationship between intelligence and success, because confirming that there is a relationship is not the "end of the road" for the researcher – the relationship has further practical implications that need to be studied.

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SUMMARY IN ESTONIAN

Intelligentsus ja sotsiaalmajanduslik edukus:
Seoste, põhjuste ja tagajärgede analüüs

Juba ammu on teada, et intelligentsed inimesed on edukamad kui vähem intelligentsed inimesed. Siiski on jätkuvalt põhjust seda teemat uurida, sest intelligentsuse ja edukuse vahelise seose põhjuste osas puudub siiamaani selge konsensus, selle seose tagajärgede uurimine on aga alles lapsekingades. Käesoleval doktoritööl on kolm eesmärki. Esiteks, kirjeldada intelligentsuse ja sotsiaalmajandusliku edukuse vahelist seost – uurida kui tugev see seos on, kas intelligentsus on sotsiaalmajandusliku edukusega tugevamalt seotud kui teiste edukuse vormidega ja kas intelligentsus mõjutab sotsiaalmajanduslikku edukust tugevamini kui teised edukuse mõjutegurid? Teiseks, analüüsida intelligentsuse ja sotsiaalmajandusliku edukuse vahelise seose põhjusi – miks see seos eksisteerib, milline on selle seose mehhanism, tänu millele saavutavad intelligentsed inimesed suuremat edu? Kolmandaks, analüüsida intelligentsuse ja sotsiaalmajandusliku edukuse vahelise seose sotsiaalseid tagajärgi – millist mõju avaldab ühiskonnale selle seose olemasolu või puudumine?

Intelligentsus on üldine vaimne võimekus, inimese võime lahendada probleeme erinevates eluvaldkondades. Edukus tähendab millegi sellise tegemist, mida peetakse ühiskonnas õigeks ja ihaldusväärseks. Sotsiaalmajanduslik edukus on edukuse vorm, mis on hõlmab hariduse, töökoha ja sissetuleku omandamist.

Doktoritöö koosneb katustekstist ja kolmest artiklist, mis on avaldatud rahvusvahelise levikuga teadusajakirjades (Strenze, 2006, 2007 ja 2013). Kõik kolm artiklit annavad omal viisil panuse intelligentsuse ja sotsiaalmajandusliku edukuse seose uurimisse. Doktoritöö katustekst paigutab artiklid üldisemasse sotsiaalteaduslikku konteksti.

Artiklite ja katusteksti baasil võib teha järgmised järeldused.
Esimene järeldus puudutab intelligentsuse ja sotsiaalmajandusliku edukuse vahelise seose üldist iseloomu. Doktoritöös antakse ülevaade paljudest teaduslikest uurimustest, kus on analüüsitud intelligentsuse ja erinevate edukuse vormide vahelist seost; samuti antakse ülevaade uurimustest, kus on analüüsitud sotsiaalmajandusliku edukuse mõjutegureid. Ülevaade näitab, et intelligentsuse ja sotsiaalmajandusliku edukuse vahel on tugev seos. Kui vaadelda intelligentsuse seost erinevate edukuse vormidega, siis torkab sotsiaalmajanduslik edukus silma, kui üks tugevamalt intelligentsusega seotud edukuse vorme. Kui vaadelda erinevate mõjutegurite seost sotsiaalmajandusliku edukusega, siis paistab intelligentsus silma, kui üks tugevamaid sotsiaalmajandusliku edukuse mõjutegureid. Seega, intelligentsus mängib tänapäeva inimeste elus olulist rolli, olles üheks tähtsaimaks eluteed kujundavaks teguriks.

Teine järeldus puudutab intelligentsuse ja sotsiaalmajandusliku edukuse vahelise seose põhjusi. Intelligentsuse ja sotsiaalmajandusliku edukuse vahelisele

seosele on sotsiaalteadustes aegade jooksul pakutud kolm erinevat seletust, millest igaüks esitab erineva nägemuse sellest, mis on intelligentsete inimeste edu aluseks. Esimese seletuse järgi saavutavad intelligentsed inimesed edu tänu oma intelligentsusele, teise seletuse järgi on intelligentsed inimesed enamasti pärit parematest sotsiaalsetest oludest ja see on nende edu aluseks, kolmanda seletuse järgi on edu aluseks see, et ühiskond usub IQ testidesse ja kasutab testide tulemusi hüvede jagamisel inimestele. Empiiriliste uuringute ja teoreetilise analüüsi baasil võib öelda, et kõik kolm mehhanismi on mingil määral tõesed, st. kõik seletavad mingi osa intelligentsuse ja sotsiaalmajandusliku edukuse seosest. Sealjuures on alust arvata, et erinevad mehhanismid on aktiivsed erinevatel aegadel ja erinevates situatsioonides. Intelligentsuse ja sotsiaalmajandusliku edukuse seose seletamisel on vaja arvestada ka ühiskondlikku konteksti – osad ühiskonnad soodustavad seda seost rohkem kui teised, seniste uuringute baasil võib öelda, et rikkamates riikides on seos nõrgem kui vaesemates riikides.

Kolmas järeldus puudutab intelligentsuse ja sotsiaalmajandusliku edukuse vahelise seose sotsiaalseid tagajärgi. On alust arvata, et intelligentsuse ja sotsiaalmajandusliku edukuse vaheline seos ühiskonnas avaldab mõju ühiskonna majanduslikule arengule. Kusjuures, mida tugevam on intelligentsuse ja sotsiaalmajandusliku edukuse vaheline positiivne seos riigis, seda kiiremini kasvab riigi majandus. Sellise mõju põhjuseks on ilmselt parem talentide kasutamine ühiskonnas – kui intelligentsed inimesed on edukad, siis tähendab see, et nende inimeste võimed leiavad ühiskonnas head rakendust ja nad panustavad seetõttu rohkem riigi majandusse. Seega ühiskond mis soodustab intelligentsete inimeste sotsiaalmajanduslikku edukust loob sellega tingimused iseenda majanduslikuks arenguks.

Järgneb lühike ülevaade doktoritöö aluseks olevatest artiklitest.
Esimene artikkel (Strenze, 2006) uuris intelligentsuse ja sotsiaalmajandusliku edukuse seost Eestis. Selleks kasutati longituudandmestikku Ühe Põlvkonna Eluteed, mille raames testiti Eesti keskkooliõpilaste intelligentsust 1983. aastal ja tehti kindlaks nende haridus, töökoht ja sissetulek 1997. aastal. Nende andmete analüüs näitas ootuspäraselt, et kõrgema intelligentsusega inimesed saavutasid hilisemas elus suuremat edu. Pakkumaks võrdlusmomenti Eesti tulemustele analüüsiti samas artiklis ka USA andmeid. Võrreldes kahe riigi tulemusi selgus, et Eestis on intelligentsuse ja sotsiaalmajandusliku edukuse seos natuke nõrgem kui USA-s.

Teise artikli (Strenze, 2007) raames teostati intelligentsuse ja sotsiaalmajandusliku edukuse vahelise seose meta-analüüs. Selleks et nimetatud seose tugevust paremini hinnata, tehti võrdluse jaoks meta-analüüs ka sotsiaalse päritolu ja sotsiaalmajandusliku edukuse vahelisest seosest. Tulemused näitasid, et nii intelligentsus kui sotsiaalne päritolu on sotsiaalmajandusliku edukusega positiivselt seotud. Intelligentsuse mõju edukusele on natuke tugevam kui sotsiaalse päritolu oma, kuid see erinevus pole suur. Veel selgus meta-analüüsist, et intelligentsuse ja sotsiaalmajandusliku edukuse seos kasvab koos

inimeste vanusega – ilmselt seetõttu, et inimesed leiavad vanemaks saades oma intelligentsile vastava positsiooni ühiskonnas. Meta-analüüs ei leidnud kinnitust populaarsele arvamusele nagu oleks intelligentsuse ja sotsiaalmajandusliku edukuse seos 20. sajandi jooksul tugevnenud.

Kolmas artikkel (Strenze, 2013) uuris riikide majandusliku arengu sõltuvust intelligentsuse ja sotsiaalmajandusliku edukuse vahelise seose tugevusest riigis. Sellist teemat on vaja uurida, sest intelligentsuse ja sotsiaalmajandusliku edukuse seose tugevus ühiskonnas näitab talentide kasutamise efektiivsust ühiskonnas – mida rohkem ühiskond võimaldab intelligentsetel inimestel hariduse ja töö valdkonnas edu saavutada, seda paremini ühiskond rakendab nende inimeste vaimseid võimeid tööturul ja seda rohkem need inimesed panustavad riigi majandusse. Riikide analüüs näitas, et mida tugevam on intelligentsuse ja sotsiaalmajandusliku edukuse seos riigis, seda kiiremini kasvab riigi majandus. Selline tulemus lubab oletada, et talentide kasutamine on riigi majandusarengut soodustav tegur.

PUBLICATIONS

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WHO GETS AHEAD IN ESTONIA AND AMERICA? A COMPARATIVE ANALYSIS OF MENTAL ABILITY AND SOCIAL ORIGIN AS DETERMINANTS OF SUCCESS

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Abstract. Status attainment research has shown that people's mental ability (intelligence) is an important determinant of their career success in western societies. But so far, no study has investigated the impact of mental ability on career success in Estonia. The present paper analyzes a longitudinal data-set from Estonia to fill this gap and compares the results with a similar data-set from the United States. The impact of mental ability is compared to the impact of social origin. Success is conceptualized as education, occupation and income of an individual. The analyses demonstrate that both mental ability and social origin have a positive effect on success in Estonia and the United States. However, the impact of mental ability is stronger in the United States and the impact of social origin is, to a lesser extent, stronger in Estonia. It can be concluded that Estonian society is less open and meritocratic than American society.

Keywords: intelligence, mental ability, status attainment, social mobility, socioeconomic status, career success, Estonia

1. Introduction

The concern about being successful, making a career, being well off, seems to be the central feature of western societies today. Although it is a common practice to denounce the purely materialistic world-view and say that 'money does not buy you happiness', the ideal of a life centered around career and consumption is still a trade-mark of western culture throughout the world. It is not surprising, therefore, that much research has been carried out to answer questions like 'who gets ahead?' (the title of an important monograph by Jencks et al. 1979), 'who wins and who loses?', 'what are the determinants of individuals' career success?'. In sociology, this kind of research is often called status attainment research. The present paper belongs to the status attainment paradigm and presents a comparative analysis of the determinants of success in Estonia and the United States. The main purpose of

the paper is to analyze mental ability (intelligence) as a determinant of success in Estonia.

1.1. Indicators of success

Status attainment research is mostly concerned with three kinds of success – educational, occupational and financial. That is, success (attained status) is conceptualized as educational level, occupational level or income of an individual. It is usually assumed that all of them can be measured on interval (or at least ordinal) scale. That is, they are assumed to order people on a *continuum* of success. But this assumption is not equally shared by all researchers. Actually, income is the only variable of the three that has no problems in this respect and this is probably the reason why economists have concentrated almost exclusively on that indicator (see Bowles et al. 2001). Education is the second least problematic because it can be quite conveniently measured by years of schooling (number of years the individual has spent studying).

Occupation is the most problematic indicator of success as far as measurement issues are concerned. There is a conflict between status attainment and class structurationist approaches (as they are called by Bond and Saunders 1999) over the proper conceptualization of occupational status. Status attainment paradigm uses occupation as a continuous variable and has generated a number of quantitative indexes to allow occupations to be measured as a social hierarchy ranging from more prestigious occupations to less prestigious ones (see e.g. Blau and Duncan 1967, Ganzeboom and Treiman 1996a). Class structurationist paradigm says that occupations cannot be ordered on a single hierarchical dimension and, instead of that, we should treat occupational groups as qualitatively different classes and study mobility between them (Erikson and Goldthorpe 1993). Since there is no easy way to reconcile these approaches, it is not uncommon to use both approaches in one paper and this will also be done in the present article.

1.2. Determinants of success – social origin and mental ability

The number of factors that can in principle influence individuals' success is enormous. However, it can be said that there are three factors, which are central to the sociological research on status attainment processes – social origin, mental ability and education. These three constitute the core of the classical models of status attainment (see Blau and Duncan 1967, Jencks et al. 1972, Sewell et al. 1969). The first two of them will be at the center of this paper. But before I look at them more closely, a few words about the third one. Education has a twofold role in status attainment research – it is an important indicator of success but it is also an important determinant of further occupational and financial success. In fact, it is probably the most important determinant of success throughout the world (Treiman and Yip 1989). *"[E]ducational attainment is the main force that drives the process of stratification"* (Ganzeboom and Treiman 1993:467) and other forces, like social origin and mental ability, are likely to have much of their

influence on occupation and income through their influence on education (Jencks et al. 1972, Sewell et al. 1969).

Social origin is usually operationalized as parental education, parental occupation, parental income or a combination of them. It has been, to a large extent, the main mission of status attainment and social mobility research to document the intergenerational transmission of social status, that is, the influence of social origin on personal success (Ganzeboom et al. 1991). And it has been established beyond doubt that the social status of an individual in adulthood is positively associated with the status of his or her parents. Comparative international studies have also shown that the relationship between father's occupation and son's occupation is stronger in non-industrialized countries (like India) than in industrialized countries (like the United States) and that this relationship has grown weaker during the 20th century (Ganzeboom et al. 1989, Treiman and Yip 1989). In other words, western countries are more open (or meritocratic) than non-western countries and the openness has been increasing.

Social origin has been the favorite determinant of success among sociologists but it is certainly not the only one. Mental ability (intelligence) is a good candidate for an alternative major determinant. The question about the relative roles of social origin and mental ability in people's career success is one of the central questions of status attainment research. It is a question about the level of meritocracy in society – whether successful people have earned their success with their own abilities or are they just lucky to have rich and educated parents (Saunders 1995, 1997)? The relationship between mental ability and career success has been studied since the first half of the 20th century (Ball 1938, Thorndike et al. 1934), but until the 1960s this research was conducted in isolation from the research on the relationship between social origin and career success, thereby leaving the door open to criticism that the positive correlation between intelligence and success might actually be the result of social origin influencing them both (McClelland 1973). Since the end of 1960s, investigators started to consider the two alternative determinants simultaneously (Duncan 1968, Jencks et al. 1972, Sewell et al. 1969) and the general conclusion from these analyses seems to be that social origin and mental ability influence status attainment, to a large extent, independently of each other.

Intelligence is, therefore, a necessary addition to the models of status attainment. But it was not until the publication of *"The Bell Curve"* in 1994 (Herrnstein and Murray 1994) that mental ability really came to the spotlight of sociologists' attention. Herrnstein and Murray performed several analyses and showed that, in the United States, intelligence has a much stronger influence on a number of positive outcomes (including income) than socioeconomic status (a combination of parental occupation, education and income). They also argued that the positive correlation between parental status and success actually results from the intergenerational genetic transmission of mental ability from parents to children. These analyses have been severely criticized for a number of reasons (see e.g. Fischer et al. 1996, Hauser and Huang 1997). At the same time in Great Britain, a similar discussion was inspired by the work of Saunders who showed that intelligence has a stronger

influence on occupational attainment than father's occupation and that Britain is, therefore, to a large extent, a meritocratic society (Bond and Saunders 1999, Saunders 1997, 2002). These conclusions were challenged by Breen and Goldthorpe (1999, 2001, 2002) who argued that Saunders greatly over-estimated the importance of intelligence. The analyses in the present paper are inspired by these controversies.

1.3. Determinants of success in Estonia

In 1940, Estonia became part of the Soviet Union; the Soviet system collapsed by the end of 1980s and Estonia was re-established as an independent republic in 1991. It seems to be a common opinion that inequality has become a great social problem in Estonia since then (Lauristin and Vihalemm 1997, Vetik 2002). It is not surprising, therefore, that quite a lot of research has been carried out to explain why some people are better off materially than others. Explanations of material success in modern Estonia include gender (men have higher incomes than women, see e.g. Murakas and Trapido 1999, Titma and Kõiv 2002), nationality (Estonians have higher incomes and better jobs than people from other nationalities, see e.g. Krusell 2002, Toomse 2003), place of residence (it is generally believed that living in a big city is a considerable advantage in career pursuits, see e.g. Titma and Taru 1999), age (older people generally feel themselves to be lower in social hierarchy, see e.g. Lauristin 2004), being born at a right time (this is the so-called 'winners generation' hypothesis, which states that people who graduated from universities in the late 1980s and early 1990s had more chance of finding a good job than older and younger generations, some support for it is presented by Murakas and Trapido [1999] and Toomse [2003]) and education (many studies have shown that education is the main road to prestigious occupation and high income in Estonia as it is in the rest of the world, see e.g. Helemäe et al. 2000).

The effects of social origin have also been investigated in a number of publications. It has been shown that parental education and occupation have a significant effect on their children's educational and occupational attainment after controlling for a number of other predictors (Titma and Kõiv 2002, Titma and Taru 1999, Toomse 2003) but there seems to be little effect on income (Titma and Kõiv 2002). Helemäe et al. (2000) have suggested that even grandparental social status has an independent effect on success in today's Estonia. Analysis of occupational attainment throughout 1990s has shown that the effect of father's education has grown stronger during that period (Toomse 2003). International comparisons with former Soviet countries have shown that the influence of father's education is stronger in Estonia and Latvia than in Russia or Ukraine (Titma et al. 2003).

All in all, these findings provide quite a good picture of the determinants of success in Estonia. But there is one important variable, which is still missing from this picture – mental ability. To my knowledge, no study has yet investigated the effects of mental ability on people's educational, occupational or financial success in Estonia within the framework of status attainment paradigm. But based on the research reviewed earlier, there is every reason to believe that intelligence might be

an important determinant of status attainment in Estonia, as it is in the United States or Great Britain.

It does not mean that there has been absolutely no research on the relationship between mental ability and some criteria of success in Estonia. In fact, a number of studies have investigated the relationship between intelligence and school grades. The earliest of them is the study by Tork, conducted in the 1930s, which reports several correlations between ability test scores and average school grades for children of about 13 years old (Tork 1940:329). The correlations are mostly between 0.50–0.60. In the Soviet period, a study of students entering universities in 1975 found a correlation of 0.59 between ability test scores and average grades in secondary school and a correlation of 0.61 between ability test scores and average grades in university (Sukamägi 1994a:155). After the Soviet period, a large-scale study conducted in 2001 with children aged 12 to 18 found correlations around 0.30 – 0.50 (with an average of 0.43) between test scores and average grades for different age and gender groups (Laidra 2002:17). A smaller study by Tina (2002) has obtained similar results. As for other criteria of success, at least one study has investigated the relationship between intelligence and supervisory ratings of job performance ($r = 0.14$, Sukamägi 1994a:155). And at least one study has found a positive relationship between intelligence and performance in military service (Seepter 2001). No study conducted so far in Estonia, however, has investigated the relationship between mental ability test scores and the kind of success criteria used in status attainment literature (see section 1.1). The present paper attempts to fill this gap by analyzing a recently gathered large longitudinal data-set from Estonia, which contains, among other things, data on intelligence test scores.

1.4. The present research

The main purpose of this paper is to analyze the role of mental ability in the status attainment process in Estonia. But it is not the only purpose – actually, the following analysis will be comparative in two senses. First, since it is not very informative to study the determinants of success in isolation, the role of mental ability in the status attainment process will be compared to the role of social origin. And second, since the results from only one country are perhaps hard to evaluate, results from the Estonian study will be compared to results from a similar longitudinal study from the United States.

The general hypothesis of this paper is that both intelligence and social origin have a positive impact on educational, occupational and financial success in Estonia and America.[1] At a more specific level, one might speculate that the influence of

[1] In this paper, intelligence and social origin are treated as theoretically independent (though empirically correlated) constructs. That is, neither of them is assumed to have a causal impact on the other. Some models of status attainment have, of course, assumed that mental ability is influenced by one's social origin (e.g. Jencks et al. 1972). Others have claimed that one's social origin is influenced by the genes for intelligence that run in the family (e.g. Herrnstein and Murray 1994). It is not possible to resolve these issues in the present paper.

intelligence (in an absolute sense and relative to the influence of social origin) should be stronger in Estonia than in America. This idea is based on the research that has shown that mental ability is especially predictive of performance in unstable laboratory environments (LePine et al. 2000) and complex working conditions (Hunter and Hunter 1984). Since Estonian society, unlike American society, has recently experienced great social transformations, the recent social context of Estonian society can be said to be more complex and unstable than the one in America. One might speculate that harsh and unstable social environment should increase the competition for scarce resources and give rise to a kind of 'survival of the most intelligent' effect, and hence the expectation of greater predictive power for intelligence in Estonia. The influence of social origin, on the other hand, can be expected to be weaker in Estonia than in America due to the same reason – the social transformations – which might have interfered with intergenerational transmission of social advantage.

On the other hand, it must be kept in mind that the United States is known for its openness and comparative research has generally found social origin to be less predictive of status attainment in America than in most western countries and other parts of the world (Erikson and Goldthorpe 1993, Ganzeboom et al. 1989). Thus, in this paper the stratification processes of relatively stable and open America are contrasted with relatively unstable Estonia. That is why it is hard to formulate any specific hypotheses about how the two countries differ in terms of the absolute and relative importance of social origin and intelligence.

2. Data and variables

2.1. Data

Data for Estonia come from a data-set called Paths of a Generation (PG), a longitudinal survey conducted under the supervision of Mikk Titma (see Titma 1999, Titma and Tuma 1995). The sample consists of about 3 000 young people who were first contacted in 1983 when they were on average 17.6 years old. They have been contacted four times so far, the last time in 1997 when they were on average 31.8 years old. During that period, Estonian society had experienced radical social transformations and, therefore, the PG sample offers a unique opportunity to study individual life-course at the time of historical changes. I use data from the first, third and fourth round of the survey. The sample surveyed by PG was chosen to be representative of the people who were graduating from secondary education in 1983. The people who had left school earlier than that are, therefore, missing from the sample, but the percentage of such people should not be large since finishing secondary education was almost compulsory in Soviet Estonia at the time (see Helemäe et al. 2000). The indicators of success – educational, occupational and financial attainment – are measured in 1997. By that time, the main political and economic transformations of Estonian society were already in the past and the social environment was characterized by growing living

standards, increasing stratification, consumerism, etc. (Lauristin and Vihalemm 1997). The median age of the respondents was 32 at the time. It can be safely assumed that most people have already started their careers by that age and can be quite reliably classified as more successful or less successful.

Data for the United States come from the National Longitudinal Survey of Youth (NLSY), a nationally representative longitudinal study of about 13 000 young people who were first surveyed in 1979 when they were on average 17.9 years old and who have been recontacted repeatedly since then (see Miller 2001). The indicators of success are measured in 1993 when the average age of the respondents was 31.9.

The two surveys are similar in many respects – both are longitudinal and were started at almost the same time (in 1979 and 1983). The median age of both samples is 18 at the first and 32 at the final measurement. The present paper, thus, covers a period of 14 years from adolescence to young adulthood. The determinants of success (social origin and intelligence) are measured at the first rounds of the surveys[2] and the actual success is measured 14 years later – this aspect of the surveys makes causal inferences possible. The two samples should be highly comparable in that respect. To ensure the comparability further, I will use similar sets of variables from both. The variables can be divided into (1) the indicators of success – education, occupation and income; (2) the central determinants of success studied in this paper – social origin and mental ability; and (3) background variables, which are not at the center of the study but which are known to influence status attainment and, therefore, have to be controlled in statistical analyses.

2.2. Indicators of success

In both surveys, the indicators of success are measured in the last rounds covered in the present paper – in 1997 in the PG and 1993 in the NLSY (the only exception is income for NLSY, as explained below).

Education. In this paper, all information about educational levels is expressed in years of schooling. In the NLSY data-set, the information about education was already coded into years of schooling. In PG survey, the respondents were asked to indicate the highest educational level they had completed (e.g. secondary education, higher education). These levels were transformed into approximate years of schooling corresponding to the levels (see Titma and Hämmal 2002).

Occupation. The respondents were asked about their current or last occupation at the time of the last survey (thus, for the respondents who were not working at the time, the last occupation was used). As mentioned above, there are two approaches to the study of occupational status in sociology. One of them uses occupation as a continuous variable and the other prefers to group occupations into nominal categories. As both approaches have their advantages, I used both.

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[2] Strictly speaking, social origin is not measured at the first round in the PG survey; the measurement was done at the third round, but it refers to the time of the first round (see below).

In the PG data-set, the occupations were originally coded into ISCO-88 (International Standard Classification of Occupations of the year 1988) categories, in the NLSY data-set the U.S. Census categories were used. I transformed both of them into the International Socioeconomic Index of Occupational Status (ISEI) and Goldthorpe's class-schema using the methodological tools provided by Ganzeboom and Treiman (1996b).

ISEI is a continuous occupational scale that assigns each occupation a score representing the "*weighted averages of standardized measures of the income and education of incumbents of each occupation.*" (Ganzeboom and Treiman 1996a: 204). That is, the higher the ISEI score of an occupation, the higher the average education and income of the people holding the occupation. The scores are also strongly related to the general prestige or desirability of occupations (Ganzeboom and Treiman 1996a). Among the highest scoring occupations are, for example, judge, medical doctor, university professor and among the lowest scoring are carbage collector, housemaid, forestry laborer, etc.

To analyze occupational status as a nominal variable, I used Goldthorpe's class-schema, which divides occupations into qualitatively different categories or classes based on a number of criteria: for instance, whether the person is an employee or self-employed, whether the nature of the work is manual or non-manual, etc. (see Erikson and Goldthorpe 1993). The most often used version of Goldthorpe's schema distinguishes seven classes; in this paper, however, a more simplified version had to be used. First, the category of self-employed workers had to be excluded because there were no self-employed people among the parents of the PG respondents (self-employed workers did not exist in the Soviet Union) and consequently, for reasons of comparability, this category could not be used for PG respondents' own occupation or for the NLSY sample.[3] Second, some of the remaining categories contained too few cases and had to be combined with others. In the end, I was left with a four-class version distinguishing the following occupational groups (see Ganzeboom and Treiman 1996a) – higher service class (e.g. member of parliament, medical doctor, university professor, lawyer), lower service class (e.g. secondary school teacher, actor, real estate agent), routine non-manual workers and skilled manual workers (e.g. secretary, cook, carpenter), and unskilled manual workers and farm workers (e.g. motor-vehicle driver, housemaid, janitor). The categories are rather heterogeneous but it is nevertheless obvious that the categories differ in terms of job rewards and desirability, the first two categories containing the most prestigious occupations and the last one containing the least prestigious ones (see Erikson and Goldthorpe 1993, Table 2.2).

Income. In the PG survey, the respondents were asked about their income from different sources during the last month. Incomes from the following sources were summed to obtain a measure of total income – job salary from main occupation,

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[3] As the class-categories will be used to conduct an analysis of social mobility (see Table 5), it is preferable that both father's and respondent's positions are measured with exactly the same categories.

income from extra work, income from business, income from trading and income from selling farm products. For NLSY, I used the 1994 survey, which asked respondents about their income in the past year (that is, their 1993 income) from the following sources – income from main occupation, income from business, income from farm. Again, the different sources were summed to obtain a measure of total income. And finally, following the usual practice (see Becker and Tomes 1986), the income measures of both surveys were transformed into logarithmic scale to obtain a normal distribution. In the logarithmic transformation, all cases with zero-values are deleted leaving only individuals with non-zero incomes.

2.3. Mental ability

Although the PG data-set has been analyzed in a number of publications (e.g. Titma 1999, 2002), its mental ability measures have not been included in any of them. The intelligence testing took place in 1983 under the supervision of Aimi Sukamägi. Unfortunately, only about half of the sample was tested and, therefore, the sample with information on ability is much smaller than the complete PG sample, but it should nevertheless be large enough to allow reliable conclusion to be made about the role of intelligence in the life course of Estonian people. The intelligence measure used in the testing was General Aptitude Test Battery (GATB), a personnel selection test created in the United States in the middle of the 20th century and translated into Estonian and Russian languages in 1970s (see Sukamägi 1994b). GATB is one of the most widely used personnel selection tests in the United States, its validity in predicting job performance has been confirmed in hundreds of studies (Hunter 1986, Hunter and Hunter 1984).

GATB consists of a number of subtests, which should measure different, potentially job-relevant, aptitudes (e.g. spatial aptitude, verbal aptitude, etc.). The PG data-set contains data on eight GATB subtests, of which three are the most important in the present context. These three are Arithmetic Reasoning (testing the ability to understand and solve mathematical problems), Vocabulary (testing the ability to understand word meanings) and Three Dimensional Space (testing the ability to visualize different geometrical shapes). The aptitudes measured by these subtests are numerical aptitude, verbal aptitude and spatial aptitude, respectively. These three subtests together constitute a composite factor called General Learning Ability (see Anastasi 1976). General Learning Ability has been described as *"[t]he ability to 'catch on' or understand instructions and underlying principles; the ability to reason and make judgements"* (Gaines and Stroupe 1994:2). It should, therefore, be the most g-loaded portion of GATB, that is, the closest thing to general mental ability in GATB. To obtain a measure of general intelligence, I used principal component analysis (as suggested by Jensen 1980) to extract a principal component from the three subtests. The principal component is standardized to have zero mean and a standard deviation of 1. The factor loadings and explained variance of the three subtests are presented in Table 1. As is evident from the table, all three subtests have fairly similar factor loadings and, therefore,

contribute equally to the principal component, which will be used as a measure of general mental ability in the rest of the paper.

Table 1. Principal component analysis – first principal components of mental ability subtests

Subtests	Estonian sample	American sample
	Factor loadings	
GATB: Arithmetic reasoning	0.82	
GATB: Vocabulary	0.79	
GATB: Three-dimensional space	0.74	
AFQT: Arithmetic reasoning		0.87
AFQT: Word knowledge		0.91
AFQT: Paragraph comprehension		0.90
AFQT: Numerical operations		0.82
Explained variance	61.12	77.14

In the NLSY, mental ability was measured around 1980 with Armed Forces Qualification Test (AFQT), a combination of tests of Arithmetic Reasoning, Word Knowledge, Paragraph Comprehension and Numerical Operations. Again, principal component analysis was used to extract a measure of general intelligence from the four subtests (see Table 1). AFQT has been used repeatedly in status attainment literature (e.g. Brown and Reynolds 1975, Nyborg and Jensen 2001). It is interesting to note that the notorious *Bell Curve* (Herrnstein and Murray 1994) also used data from the NLSY and its conclusions about the role of mental ability are based on the analyses of the same AFQT scores. AFQT is actually part of a larger test, Armed Services Vocational Aptitude Battery (ASVAB); it is the most g-loaded portion of ASVAB (Herrnstein and Murray 1994), just like the General Learning Ability is the most g-loaded portion of GATB. ASVAB and GATB are known to be similar in content as both were constructed for the purpose of personnel selection (see e.g. Schmidt et al. 1992); therefore, the ability measures of the two data-sets provide a good basis for comparative analysis.

There has been some discussion in the personnel selection literature over whether it is appropriate to combine tests of specific aptitudes into a single measure of general ability (see Schmidt et al. 1992), for it is possible that specific aptitudes might be better predictors of job performance than general ability. Several studies have shown, however, that this is not the case – tests of specific aptitudes are not better predictors of performance than tests of general intelligence (Hunter 1986; Ree et al. 1994). This question has not been systematically investigated in the status attainment literature, but the correlations presented by Jencks et al. (1979, Tables 4.1 and A2.9) suggest the same conclusion – general ability (a combination of scores on several subtests) correlates higher with educational, occupational and income attainment than any of the subtests. Since it is a very important question methodologically, it will also be briefly addressed in this paper.

2.4. Social origin

Father's and mother's occupation. These variables refer to parental occupations at the time of the first survey in both samples. In the PG sample detailed information about parental occupations was obtained in the third (1993) round of the survey – every respondent was asked what were his or her father and mother (or stepfather and stepmother) doing when the respondent graduated from secondary school. If the information for that time was missing, parents' occupations at the time the respondent graduated from primary school were used instead. Parental occupations were coded into ISEI scores and Goldthorpe's categories the same way as respondents' own occupations.

Father's and mother's education. Respondents were asked about the current level of education of their parents in the first round of the survey in both samples.

Material well-being of the family of origin. The 1979 round of NLSY obtained information about the total family income of respondents' family in the past year. Only those respondents who were living with their parents in 1979, and for whom family income refers to their parents' income, are included in this paper. PG does not contain any information about parental income, but the respondents were asked about the material well-being of their family in 1983 – a list of items was presented to them and they had to indicate for every item, whether their family had it (= 1) or not (= 0). The answers were summed. The items used in this paper are: own house, summer house, private flat, own car, color TV, radio, tape recorder, new furniture, works of art, library with more than 200 books, respondent's own room.

Index of socioeconomic status (SES). I constructed a general index of socioeconomic status by extracting a principal component from the three measures of parental status – mean parental education (if information was missing for one parent, only the one of the non-missing information was used), mean parental occupation (measured with ISEI; again, if information was missing for one parent, only the one of the non-missing information was used) and material well-being of the family of origin. The factor scores of the principal component will be used as general measures of SES. The principal component has a mean of 0 and a standard deviation of 1. The factor loadings for both data-sets are presented in Table 2. As is evident from the table, the two SES measures are quite similar in terms of factor loadings and explained variance.

The reason for using a combined index of SES instead of single variables of parental status is similar to the reason for preferring general mental ability over specific aptitudes – it should be a better predictor of success than any of the single measures since different parental characteristics are, to some extent, independent of each other, and a combination of them should, therefore, explain more variance in the dependent variable. In support of that reasoning, White's review has shown that the measures of social origin that combine two or more parental characteristics into one index are better predictors of children's academic achievement than single parental characteristics (White 1982, Table 6). For that reason, such combined indices are often used in the status attainment literature (e.g. by Herrn-

stein and Murray 1994, Sewell et al. 1969). But their use has also been criticized and some authors prefer not to combine different parental characteristics into one index (e.g. Fischer et al. 1996). This issue will also be briefly addressed below.

Table 2. Principal component analysis – first principal components of parental characteristics

	Estonian sample	American sample
Parental characteristics	Factor loadings	
Parental education	0.89	0.83
Parental occupation	0.89	0.84
Material well-being	0.52	0.70
Explained variance	61.47	62.92

2.5. Background variables

Age. The age of the respondents does not have much variance in either samples but it still seems appropriate to control for it. Especially since it has been pointed out that AFQT scores should never be used without age as a control variable (Herrnstein and Murray 1994).

Gender. This variable is coded 1 if the respondent is male and 2 if the respondent is female.

Ethnicity. The function of this variable is to indicate whether the respondent belonged to the 'dominant' ethnic group or not. It has somewhat different meanings in Estonia and America. In the Estonian sample it means that the respondent's main language in 1983 was either Estonian (= 1) or something else (= 0). The best corresponding variable for it in the American study seems to be racial origin – whether the respondent is White (= 1) or Black, Hispanic or something else (= 0).

Residence. The nature of the place of residence at the time of the first survey is captured by a five-point variable (1 = in the country, …, 5 = in the capital city) in Estonia and a two-point variable (1 = rural area, 2 = urban area) in the United States. Residence at the time of the first survey, rather than the last survey, is used because the latter might be influenced by the career choices of the respondents.

3. Results

The analytical strategy of the paper will be following. At first, simple bivariate relationships are calculated in order to ascertain that there is a positive relationship between social origin and mental ability on the one hand, and attained status on the other hand. Next, more complicated multivariate regression analyses will be conducted to find out if social origin and mental ability influence status attainment independently of each other and background variables. A further aim of the multivariate analysis is to compare these influences in Estonia and America, and to shed

light on one of the big questions of status attainment research – which one is more important, social origin or mental ability? The common practice, in answering the latter kind of question, is to compare the size of the standardized regression coefficients of the variables. But it should be noted that some authors (e.g. King 1986) have expressed doubts about the rationality of this practice. King claims that it makes no sense to compare the size of regression coefficients (even standardized ones) of independent variables, which have a different metric (see also Breen and Goldthorpe 1999, 2001). In this paper, the measures of SES and general mental ability are obtained factor analytically, by combining several original variables; both are standardized to have a mean of 0 and a standard deviation of 1. The metric of the variables is, thus, similar in terms of statistical properties, but also substantively in the sense of being abstract and not having an intuitively meaningful unit of measurement. Therefore, I believe that the two variables have been rendered as similar as they possibly can be.

In Table 3, indicators of success are correlated with index of socioeconomic status, single measures of parental status, general mental ability and subtests of ability.[4] The most general result from the correlational analysis is that all the correlations are positive and significant at the 0.001 level. Thus the basic zero-order relationship of mental ability and social origin with success is positive in both countries.

Table 3. Correlations of indicators of success with social origin and mental ability

	Estonian sample			American sample		
	Education	Occupation	Income	Education	Occupation	Income
SES index	0.44	0.44	0.22	0.47	0.31	0.22
Indicators of social origin						
Father's education	0.35	0.35	0.18	0.42	0.26	0.17
Mother's education	0.40	0.37	0.18	0.41	0.23	0.15
Father's occupation	0.38	0.37	0.19	0.40	0.28	0.16
Mother's occupation	0.39	0.37	0.18	0.33	0.25	0.16
Material well-being	0.15	0.19	0.15	0.28	0.21	0.19
General mental ability	0.47	0.39	0.28	0.60	0.45	0.31
Subtests of mental ability						
GATB: arithmetic reason.	0.39	0.32	0.23	–	–	–
GATB: vocabulary	0.50	0.43	0.23	–	–	–
GATB: 3-dimensional	0.22	0.16	0.17	–	–	–
AFQT: arithmetic reason.	–	–	–	0.54	0.39	0.31
AFQT: word knowledge	–	–	–	0.55	0.41	0.28
AFQT: paragraph comp.	–	–	–	0.54	0.41	0.25
AFQT: numerical operat.	–	–	–	0.50	0.38	0.26

Note: All correlations are significant at the 0.001 level. Missing data are deleted pairwise.

[4] To waste as little data as possible, missing data were deleted pairwise. Therefore, sample size is different for every correlation; it ranges from 782 (correlation between general mental ability and income in the Estonian sample) to 8603 (correlation between general mental ability and education in the American sample).

The correlations in Table 3 also allow us to make an important methodological observation. If we compare the correlations of combined indices with those of single variables, we see that the combined index of SES has stronger correlations with indicators of success than any of the single measures of social origin; therefore, the combined index is an improvement over the single measures used separately. The same is true for specific aptitudes and general mental ability in the American sample – general ability is a better predictor of success than any of the specific aptitudes. It does not seem to be so in Estonia, since here the Vocabulary test (i.e. verbal aptitude) has stronger correlations with education and occupation than general intelligence, but actually the differences between the correlations are not significant ($z = 0.90$, $p = 0.37$ [two-tailed], for correlations with education; $z = 1.09$, $p = 0.28$ [two-tailed] for correlations with occupation). Therefore, these results support the conclusion that general combined indices are better predictors of status attainment than single variables.

Table 4 presents a series of linear regression models that investigate social origin, mental ability and background variables as predictors of success in the two samples. There are three regression models for both countries; for every model unstandardized (B) and standardized (β) regression coefficients, significance levels (p), a measure of explained variance (R^2) and sample size (N) are presented. For the purposes of comparative analysis, it is useful to keep in mind that if we want to compare the impact of the same independent variable in different samples, then we should look at unstandardized coefficients, but if we want to compare the relative importance of different independent variables in the same model, then we should look at standardized coefficients (see Kline 1998).

The models I, II and III give us a simplified picture of the status attainment process, assuming that education is the first 'stage' of status attainment and income is the last one – model I investigates educational attainment, model II investigates occupational attainment, including education as one of the predictors, and model III investigates income attainment, including education and occupation as predictors[5] (see e.g. Sewell et al. 1969 for a similar analysis). These three models demonstrate that status attainment is a cumulative process – social origin and mental ability are the main determinants of education, education is in turn the main determinant of occupation, and occupation (along with gender) is the main determinant of income. SES and intelligence, therefore, have most of their influence on the status attainment process through education. This result is consistent with previous studies (e.g. Sewell et al. 1969).

If we compare the influence of mental ability in the two samples, then we can see that the effects are stronger in the United States for all three dependent variables. For instance, raising one's intelligence by a standard deviation (and controlling for other predictors) would give 3.53 additional occupational status

[5] Model III includes only the respondents who were working at the time the income measure was taken since it makes little sense to use last occupation to predict current income of the people who are not working. I ran similar regression models with all respondents, including the ones who were not working, and the results were very similar to the ones presented in Table 4.

Table 4. Linear regression - prediction of educational, occupational and income attainment

Independent variables	Dependent variables								
	Education (Model I)			Occupation (Model II)			Income (Model III) [a]		
	B	β	p	B	β	p	B	β	p
				Estonian sample					
Constant	10.15		***	–14.95			6.25		***
Age	0.06	0.02		–0.20	–0.01		0.10	0.10	*
Gender	0.76	0.16	***	2.38	0.07	**	–0.54	–0.36	***
Ethnicity	0.13	0.02		4.62	0.12	***	0.05	0.03	
Residence	0.05	0.03		1.20	0.10	***	0.03	0.05	
SES index	0.72	0.30	***	1.95	0.12	***	0.04	0.05	
General mental ability	0.83	0.36	***	0.56	0.03		0.09	0.12	**
Education				4.31	0.61	***	0.02	0.05	
Occupation							0.01	0.27	***
R^2	0.32			0.55			0.28		
N	791			771			524		
				American sample					
Constant	14.63		***	7.39		**	9.45		***
Age	–0.01	–0.01		–0.25	–0.03	**	0.01	0.02	
Gender	0.20	0.04	***	3.88	0.13	***	–0.47	–0.30	***
Ethnicity	–0.99	–0.21	***	–0.83	–0.03		–0.03	–0.02	
Residence	–0.10	–0.02		1.12	0.03	*	0.08	0.04	**
SES index	0.62	0.26	***	0.52	0.03	*	0.05	0.06	**
General mental ability	1.37	0.56	***	3.53	0.22	***	0.14	0.17	***
Education				2.55	0.39	***	0.04	0.10	***
Occupation							0.01	0.25	***
R^2	0.42			0.34			0.28		
N	4899			4239			3267		

[a] – only these respondents are included who were working at the time the income measure was taken.
* – $p < 0.05$, ** – $p < 0.01$, *** – $p < 0.001$

points in America, while in Estonia it would only be 0.56 points (see model II). The predictive power of SES, on the other hand, seems to be stronger in Estonia (though, in general, it is more equal in the two countries) – one standard deviation increase in SES would raise one's occupational status by almost two points in Estonia but only half a point in America (see model II).

Comparison of the relative importance of SES and intelligence shows that, in the American sample, the influence of intelligence is, at every step, stronger than that of SES – intelligence has a much stronger impact on educational attainment (model I) and manages also to have a much stronger impact on occupational attainment when education is controlled for (model II) and on income when both

education and occupation are controlled for (model III). In other words, it means that most people with high mental abilities get a good education but those who do not can still get a high-status occupation thanks to their mental abilities and those who do not get either good education or high-status occupation can still earn a lot of money thanks to their mental abilities (the same is also true for SES but to a much lesser degree). In the Estonian sample, SES and intelligence have a more or less equal effect on educational attainment (model I). As for occupational attainment, intelligence has no effect when education is controlled for while SES has a significant independent effect (model II), and as for income, the roles are reversed – intelligence has a significant effect, which is independent of education and occupation while SES has none (model III). Thus, while children of higher social background and higher intelligence both get a good education, those from higher background do not need a good education to get a prestigious job and those with higher intelligence do not need a good education or a prestigious job to earn a high income.

The analysis so far has tried to capture the linear relationships between independent and dependent variables. This analysis is problematic for at least two reasons, as already mentioned. First, a number of authors doubt if occupational status can be expressed in an ordinal and continuous fashion required by linear methods (see e.g. Erikson and Goldthorpe 1993). And second, it is not clear whether the kind of 'variable race' presented above (i.e. comparing the size of regression coefficients) is an appropriate method for investigating the relative effects of independent variables (King). According to Breen and Goldthorpe (1999, 2001) one should study class mobility instead of occupational attainment, that is, the movement of individuals between origin and destination classes, not the association between parental and own prestige level. According to these authors, the proper way to study the influence of social origin, mental ability and education on occupation consists of first "…*capturing the prevailing pattern of association between origins and destinations*", and then, as a next step, one should "… *introduce measures of individual ability /…/ and educational attainment and examine the effects of doing so on the parameters initially established. To the extent that these parameters shift towards zero, the association between class origins and destinations can be regarded as being mediated by the merit variables* [i.e. mental ability and education]" (Breen and Goldthorpe 2001:89).

To perform the kind of analysis on the PG and NLSY samples, I recoded father's occupation (class of origin) and respondent's own occupation (destination class) into Goldthorpe's class schema as described in section 2.2. It is convenient to start the analysis with simple cross-tabulations of father's and respondent's positions (see Table 5). This table can be first of all treated as a mobility table showing the frequencies of different origin–destination combinations, i.e. the intergenerational mobility in Estonia and the United States (including only cases for which data on intelligence are available). Although the cases are quite equally distributed over the table, we can still discern a tendency for children to end up in classes similar to their fathers'. Table 5 also presents the average mental abilities

for every cell in the table (for this analysis, general mental ability is standardized to have a mean of 100 and a standard deviation of 15), which allows us to get a preliminary idea of how much social mobility is mediated by intelligence. And indeed, we can see that the people who were upwardly mobile tend to have higher average abilities than those who were downwardly mobile. The differences are in many cases quite dramatic, which suggests a conclusion that upward or downward mobility depends, to a considerable degree, on mental ability.

Table 5. Crosstables of father's and respondent's class positions

Father's class			Respondent's class				Total
			I	II	III	IV	
			Estonian sample				
I	Higher service class	mean IQ	110.56	108.84	101.91	110.52	107.95
		N	46	38	29	8	121
II	Lower service class	mean IQ	110.54	102.64	102.43	99.86	104.55
		N	25	27	22	11	85
III	Routine non-manual, skilled manual	mean IQ	108.58	104.38	96.31	89.96	99.24
		N	28	74	115	33	250
IV	Unskilled workers, farm workers	mean IQ	111.53	103.61	93.61	91.36	96.81
		N	20	49	104	54	227
	Total	mean IQ	110.25	104.83	96.37	93.25	100.63
		N	119	188	270	106	683
			American sample				
I	Higher service class	mean IQ	117.83	114.82	111.45	105.57	113.50
		N	95	188	158	42	483
II	Lower service class	mean IQ	114.92	111.39	105.06	100.10	108.10
		N	149	361	360	124	994
III	Routine non-manual, skilled manual	mean IQ	111.35	106.37	99.22	92.87	100.58
		N	154	468	917	406	1945
IV	Unskilled workers, farm workers	mean IQ	106.07	102.90	95.79	89.46	95.93
		N	83	289	686	427	1485
	Total	mean IQ	112.83	108.20	100.01	92.84	101.99
		N	481	1306	2121	999	4907

Note: mental ability (IQ) is standardized (m = 100, SD = 15).

This conclusion cannot be verified without a more sophisticated analysis. Therefore, I will next use multinomial regression to conduct the kind of analysis suggested by Breen and Goldthorpe (2001, see above). Multinomial regression is a method for categorical dependent variables, it estimates the probability of getting into a specified category compared to the probability of getting into a reference category. I will use the third occupational group (routine non-manual and skilled manual workers) as a reference category. As before, three regression models are

presented for both samples; for every model logit coefficients, an index of model fit (Nagelkerke R^2) and sample sizes (N) are presented (see Table 6).

Table 6. Multinomial logistic regression - prediction of respondent's class position

Independent variables	Dependent variable: respondent's class (reference category – class III)								
	I	II	IV	I	II	IV	I	II	IV
	(model I)			(model II)			(model III)		
	Estonian sample								
Constant	4.66*	0.80	0.57	–0.16	–2.05	3.56	–12.91**	–8.50**	4.50
Age	–0.34**	0.01	0.13	–0.09	0.03	–0.10	0.06	0.03	–0.09
Gender	–0.97***	–0.46**	–1.63***	–0.63*	–0.06	–1.70***	–1.43***	–0.61*	–1.66***
Ethnicity	1.24	0.61**	–0.49*	0.87	0.67*	–0.26	0.77	0.79*	–0.24
Residence	0.19**	0.11	–0.35***	0.14	0.18*	–0.17	0.05	0.14	–0.17
Father's class									
I higher service	1.52***	0.68**	0.02	1.50***	0.43	0.27	1.02*	0.06	0.38
II lower service	0.93**	0.58**	0.20	1.32*	0.47	0.82	0.79	0.07	0.87
III routine, skilled	–	–	–	–	–	–	–	–	–
IV unskilled, farm	–0.12	–0.09	0.64***	–0.12	–0.23	0.63*	–0.15	–0.23	0.65*
Mental ability				0.89***	0.61***	–0.30*	0.28	0.14	–0.27
Education							0.91***	0.61***	–0.10
N	235	360	267	117	186	106	117	186	106
N (reference cat.)	516			268			268		
Nagelkerke R^2	0.26			0.34			0.55		
	American sample								
Constant	–2.46***	–1.87***	1.56***	–0.09	–0.29	0.26	–7.25***	–6.18***	1.95***
Age	0.02	0.05**	0.02	–0.06*	0.01	0.05*	–0.03	0.04*	0.04*
Gender	–0.53***	–0.08	–1.31***	–0.51***	–0.09	–1.25***	–0.55***	–0.13	–1.12***
Ethnicity	0.54***	0.19*	–0.38***	–0.34*	–0.36***	–0.04	0.06	–0.19	–0.12
Residence	0.35*	0.11	–0.34***	0.22	0.01	–0.26*	0.21	0.01	–0.26*
Father's class									
I higher service	1.15***	0.79***	–0.47*	0.48**	0.40**	–0.05	–0.11	–0.10	0.05
II lower service	0.77***	0.61***	–0.21	0.50***	0.43***	0.01	0.21	0.21	0.03
III routine, skilled	–	–	–	–	–	–	–	–	–
IV unskilled, farm	–0.28	–0.16	0.32***	–0.06	–0.07	0.27**	0.07	0.03	0.25**
Mental ability				1 .46***	0.80***	–0.50***	0.80***	0.31***	–0.39***
Education							0.45***	0.38***	–0.12***
N	494	1328	1011	476	1289	973	476	1289	973
N (reference cat.)	2172			2088			2088		
Nagelkerke R^2	0.15			0.28			0.37		

Note: Coefficients are logit coefficients. I – higher service class, II – lower service class, IV – unskilled and farm workers, III – routine non-manual and skilled manual workers
* – $p < 0.05$, ** – $p < 0.01$, *** – $p < 0.001$

Model I in Table 6 shows the influence of father's occupational group on respondent's occupational group, controlling for background variables. It can be seen that of the nine possible associations, five are significant in Estonia and six in the USA, which means that people are more likely to end up in classes similar to

their father's class than in a reference class. Mental ability is entered in model II. It has a positive effect on getting into categories I and II, and protects against falling into category IV. But it does not have much depressing effect on the parameters of father's occupation in the Estonian sample; in the American sample the effect is considerable, though the effect of father's class still remains significant. The influence of class of origin is, therefore, not completely mediated by intelligence in either countries. Adding respondent's education in model III has a noticeable effect in both samples – the influence of father's class (as well as that of intelligence) is further reduced and, in the end, only two parameters remain significant in the Estonian sample and one in the American sample. In Estonia, those whose fathers were of higher service class still have a good chance of ending up in the same class irrespective of their personal intelligence or education, and those whose fathers were unskilled or farm workers find it hard to leave this category irrespective of their intellectual and educational level; in America, only the latter association remains significant. It can be concluded that, based on the logic of Breen and Goldthorpe (1999, 2001), social mobility is to a large extent, but not completely, mediated by intelligence and education (the 'merit variables' according to Breen and Goldthorpe) in both countries.

4. Conclusions

The present paper analyzed the determinants of educational, occupational and financial success in Estonia and the United States. The main improvement of this paper over the previous ones was the inclusion of mental ability among the predictors of success in Estonia. It was hypothesized that mental ability, as well as its main 'competitor', social origin, have a positive impact on success in both countries. The hypothesis was supported. This paper, therefore, repeated the findings of many previous studies about the positive impact of intelligence and social origin in America. It also confirmed the results of earlier analyses, which have shown that, despite the radical social transformations of Estonian society in the past decades, the cards have not been completely reshuffled and parental status during Soviet times has a significant influence on their children's social status in capitalist Estonia. But most importantly, it showed that mental ability is also a strong predictor of success in Estonia. Indeed, it seems to be the strongest predictor of educational success (see Table 4, model I) and one of the strongest predictors of income along with gender and occupational status (see Table 4, model III). Thus, it can be concluded that the most intelligent people in today's Estonia are also among the best-educated and highest-earning ones.

The second aim of the paper was to compare the impacts of intelligence and social origin in the two countries and thereby evaluate the openness (or level of meritocracy) of Estonian society against the American society. The results showed that, although mental ability is an important determinant of success in Estonia, it does not seem to be as important in Estonia as it is in the United States. The results

for the American sample showed that, as a predictor of success, mental ability outcompetes social origin for every criteria (see Table 4). The results of the 'variable race' are much more even in the Estonian sample, and indeed for occupational attainment they seem to be in favor of social origin. If we take the predictive power of mental ability to be the measure of meritocracy (as is done by Saunders 1995, 1997), then it would seem that America is more meritocratic than Estonia. The analysis of social mobility in Table 6 further demonstrated that, although the process of mobility is, to some extent, mediated by intelligence in both countries, the mediating effect is stronger in America and, thus, the level of meritocracy is lower in Estonia.

These differences in results cannot be easily attributed to methodological differences between data-sets since a number of steps were taken to assure that the variables used in this paper were measured in a similar manner (e.g. the mental ability measures were derived from similar test batteries, occupational status measures were based on the same indices, etc.). It is also important that both studies were dealing with the same period from people's life-course – the 14 years between ages 18 and 32. Based on these methodological similarities and the fact that both data-sets are representative of a large part of respective populations, it seems necessary to conclude that the differences stem from differences between the two societies.

For some reason, American society provides more opportunity for intelligent people to be successful and somewhat less opportunity for intergenerational transmission of social advantage than Estonian society. One possible reason for this difference is the stability of the two societies. Although it was speculated above that the relatively unstable and harsh social environment of Estonia during recent decades might rise the importance of mental ability in status attainment, it seems that actually the opposite is true – stable and open social environment in America seems to provide better conditions for people to fully use their intellectual capabilities in the labor market and, possibly, for the formation of cognitive elite (as suggested by Herrnstein and Murray 1994). If this is true, then the advantage of being intelligent should grow in Estonia as society matures and becomes more stable. Hopefully, future longitudinal studies will address this question. This study has demonstrated that a comprehensive treatment of inequality and career success in Estonia is not possible without taking account of people's mental ability.

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II

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Intelligence and socioeconomic success: A meta-analytic review of longitudinal research ☆

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Abstract

The relationship between intelligence and socioeconomic success has been the source of numerous controversies. The present paper conducted a meta-analysis of the longitudinal studies that have investigated intelligence as a predictor of success (as measured by education, occupation, and income). In order to better evaluate the predictive power of intelligence, the paper also includes meta-analyses of parental socioeconomic status (SES) and academic performance (school grades) as predictors of success. The results demonstrate that intelligence is a powerful predictor of success but, on the whole, not an overwhelmingly better predictor than parental SES or grades. Moderator analyses showed that the relationship between intelligence and success is dependent on the age of the sample but there is little evidence of any historical trend in the relationship.

Keywords: Intelligence; Socioeconomic success; Career success; Status attainment; Meta-analysis

Contents

☆ A detailed Appendix to this meta-analysis is available at www.zone.ee/tstrenze/meta.xls. The author wishes to express his gratitude to the reviewers for their helpful comments.
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1. Introduction

Decades of research on human mental abilities have demonstrated that the scores of intelligence tests are positively correlated with several desirable outcomes and negatively correlated with several undesirable outcomes. One of the central and personally most relevant desirable outcomes is socioeconomic success (or career success), which is usually measured by the educational level, occupational prestige, and income of an individual in adulthood. Although it is sometimes claimed in popular press and textbooks that intelligence has no relationship to important real-life outcomes (see Barrett & Depinet, 1991, for a review of such claims), the scientific research on the topic leaves little doubt that people with higher scores on IQ tests are better educated, hold more prestigious occupations, and earn higher incomes than people with lower scores (Gottfredson, 1997, 2003; Jensen, 1980, 1998; Schmidt & Hunter, 2004).

Thus, the existence of an overall positive correlation between intelligence and socioeconomic success is beyond doubt. But quite surprisingly, the mere existence of this correlation seems to be the only fact that is established beyond doubt after many decades of research. Several major questions are still without definite answers and continue to arouse heated debates (the debate about *The Bell Curve* being a prominent example in recent decades; see Herrnstein & Murray, 1994; Fischer et al., 1996). First, what is the approximate size of the correlation between intelligence and success? Is it large enough to be of any practical importance? While some researchers have said that this correlation is *"larger than most found in psychological research"* (Schmidt & Hunter, 2004: 162), others are convinced that "*IQ is just not an important enough determinant of economic success*" (Bowles & Gintis, 2002: 12). Second, how does the predictive power of intelligence compare to the predictive power of other variables, such as parental socioeconomic status (SES) or school grades? On the one hand there are studies showing that "*individual ability is by far the strongest influence on occupational achievement*" (Bond & Saunders, 1999: 217). And yet other studies conclude that "*the effect of socioeconomic background on each of the three adult status variables – schooling, income, and occupational status – is greater than the effect of childhood IQ*" (Bowles & Nelson, 1974: 44). Third, are there any age-related or historical changes in the relationship between intelligence and success? The question of historical changes in the importance of IQ has been particularly controversial with some authors warning against increasing cognitive stratification (Herrnstein

& Murray, 1994) and others trying to disprove these claims (Hauser & Huang, 1997).

The present paper will address these questions by conducting a meta-analysis of the longitudinal research on the relationship between intelligence and socioeconomic success. I will concentrate on longitudinal studies (where intelligence is measured before the actual success) because only longitudinal research design allows us to make conclusions about the possible causal impact of intelligence on success.

2. A brief history

Longitudinal studies on the relationship between intelligence and career success have been conducted since the first decades of the 20th century (Ball, 1938; Thorndike et al., 1934). And these studies have invariably uncovered a positive relationship. The early studies, however, did not consider other possible determinants of success, most importantly parental SES. Therefore, they were open to the criticism that the positive relationship between intelligence and success might actually be the result of parental SES influencing them both (Bowles & Gintis, 1976; McClelland, 1973). At the end of 1960s, with the inception of the status attainment research paradigm, investigators started to construct more sophisticated models of career advancement that considered several determinants of success at the same time (Duncan, 1968; Jencks et al., 1972; Sewell, Haller, & Ohlendorf, 1970).

But it was with the publication of The Bell Curve in 1994 (Herrnstein & Murray, 1994) that the question of intelligence and socioeconomic success really came to public attention. Analyzing a representative longitudinal data set from the United States, Herrnstein and Murray found that intelligence is a better predictor of several desirable outcomes (e.g., not living in poverty, not being arrested) than is parental SES. They also found evidence that the role of intelligence in status attainment has been growing throughout the 20th century and concluded that the social structure of American society is increasingly based on mental ability. The ideas of The Bell Curve have been severely criticized for a number of reasons. Fischer et al. (1996) argued that Herrnstein and Murray used an inappropriate measure of parental SES and, therefore, underestimated its importance. Hauser and Huang (1997) argued that the claim about the growing importance of intelligence is simply a misinterpretation of previous research. Other researchers have, however, supported the ideas of The Bell Curve (Gottfredson, 2003; Jensen, 1998) saying that its central claims have been convincingly confirmed (Nyborg, 2003: 459).

At the same time in Great Britain, a similar discussion was inspired by the work of Saunders who, analyzing a representative longitudinal data set from Great Britain, found that intelligence is a better predictor of occupational attainment than is parental SES and concluded that England is, to a large extent, a meritocratic society (Bond & Saunders, 1999; Saunders, 1997, 2002). These conclusions were challenged by Breen and Goldthorpe (1999, 2001) who argued that Saunders greatly overestimated the importance of intelligence by using inappropriate analytic techniques.

3. Previous reviews

There have been surprisingly few attempts to systematically review the literature on intelligence and socioeconomic success. Reviewers typically cite only a couple of studies (see e.g., Brody, 1997; Farkas, 2003; Schmidt & Hunter, 2004). Some of the most comprehensive reviews have been conducted by Jencks (see Jencks et al., 1972, 1979). Two meta-analyses have so far addressed the relationship between intelligence and socioeconomic success. Both of them used income as a measure of success. The more comprehensive one of the two was conducted by Bowles, Gintis, and Osborne (2001). They assembled 65 estimates from 24 studies to estimate the relationship between intelligence and income. The mean standardized regression coefficient of intelligence on income is .15 according to their study (p. 1154). In addition to that, Bowles et al. (2001) reported that there is no time trend in the size of the coefficients between the years 1960 and 1995 and that the age of the sample at the time of ability testing has no effect on the results.

The meta-analysis of Bowles et al. is a valuable contribution but it suffers from several shortcomings. First, it considered only one measure of success, income, thereby ignoring education and occupation. Second, the meta-analytic estimate of .15 was not derived from zero-order correlations as is usually required by the textbooks of meta-analysis (see Hunter & Schmidt, 2004: 475) but from regression equations that included several predictors in addition to intelligence. Peterson and Brown (2005) have recently suggested that the use of partial effect sizes, instead of zero-order ones, does not affect the meta-analytic results very much but it is nevertheless obvious that the use of disparate studies makes the results difficult to interpret. Third, the meta-analysis of Bowles et al. was not based on independent samples. The authors stated that they used 65 estimates from 24 studies (p. 1154) but neither of these figures

represents the number of independent samples. Inspection of the appendix (not published but available from the authors) leaves no doubt that some samples contributed more than one coefficient to the final meta-analytic estimate thereby ignoring the requirement of independent data (see Hunter & Schmidt, 2004, chapter 10). Fourth, their meta-analysis mixed cross-sectional and longitudinal studies. The distinction between cross-sectional and longitudinal study design is vital in the present context because only the latter can answer questions about the causal impact of intelligence on career success.

Another, more recent, meta-analysis was conducted by Ng, Eby, Sorensen, and Feldman (2005) who collected 8 studies and found an average correlation of .27 between intelligence and salary. The meta-analysis of Ng et al. (2005) was, unlike the one by Bowles et al., based on zero-order correlations and avoided the use of non-independent samples but it failed to separate cross-sectional and longitudinal studies.

4. Topics addressed in the present paper

4.1. The size of the correlation between intelligence and success

Meta-analyses are often conducted with the aim to determine if a statistical relationship between two variables is significantly different from zero. This cannot be the only aim of the present meta-analysis because very few social scientists would doubt that there is a positive correlation between intelligence and socioeconomic success. Having acknowledged that, the next logical question is: what is the approximate size of the correlation? Answers to this question are far from uniform. Take the correlation between intelligence and income: Jensen has suggested that it is somewhere around .40 (Jensen, 1998: 568) while Bowles et al. (2001) have found that it is only about .15. That is why the first aim of the present meta-analysis is to estimate the approximate sizes of the correlations between intelligence and measures of success. The importance of the correlations can be evaluated using Cohen's classification scheme which classifies correlations as small if they are below .30, medium-sized if they are between .30 and .50, and large if they are over .50 (Cohen, 1988). Knowing the size of the correlation between intelligence and career success would allow us to compare it to other, well-established, correlations in the social scientific literature; e.g., the correlation of .51 between intelligence and job performance (Schmidt & Hunter, 1998).

4.2. Intelligence and other predictors of success

It is difficult to evaluate the importance of a predictor in isolation; it would be informative to compare the predictive power of intelligence to the predictive power of other relevant predictors of socioeconomic success. This paper will, therefore, analyze two additional predictors – parental SES (e.g., father's occupation) and academic performance (e.g., school grades) – with the aim to determine if intelligence is a better predictor of success than the other two variables. Parental SES and academic performance have often been treated as the main "competitors" of intelligence in predicting career success because, as explained shortly, they represent different views about a typical path to success. Including them in this paper will, consequently, allow us to better evaluate the role of intelligence in people's career.

4.2.1. Intelligence versus parental SES

The question about the relative importance of intelligence and parental SES in predicting success is one of the central questions of status attainment research. This is a question about the nature of the society we live in: whether a typical western society rewards people for their own abilities or their social background (Saunders, 1997; Turner, 1960)? But we are far from having a definite answer to this question. Some authors have found that intelligence outcompetes parental SES as a predictor (Herrnstein & Murray, 1994; Murray, 1998; Saunders, 1997). Others have replied that parental SES, if properly measured, is actually a better predictor (Bowles & Nelson, 1974; Fischer et al., 1996). The seemingly greater predictive power of intelligence in some studies results from the failure to correct for measurement error in the measures of parental SES (Bowles & Nelson, 1974) and the failure to include important aspects of parental status (most importantly, parental income) among the predictors (Bowles & Nelson, 1974; Fischer et al., 1996).

Therefore, it is necessary to compare the correlation between intelligence and success with the correlation between parental SES and success. To accomplish that, the present paper will include a meta-analysis of the relationship between the different aspects of parental SES (parental education, occupation, and income) and socioeconomic success. Research on this relationship is, of course, voluminous and several narrative and quantitative reviews of it are available (see Ganzeboom, Luijkx, & Treiman, 1989; Haveman & Wolf, 1995; Mulligan, 1999). Ganzeboom et al. (1989), for instance, gathered 149 studies from 35 countries to analyze the

association between father's occupation and son's occupation, and concluded that the association is stronger in non-industrialized societies and has been weakening during the 20th century. But none of these reviews has presented the results in a manner that would make them directly usable in this paper, hence the need for a separate meta-analysis.[1]

4.2.2. Intelligence versus academic performance

The question about the relative importance of mental ability and academic performance in predicting success has also been recognized as important (see Jencks & Phillips, 1999). It is a question of what really matters for career success: is it one's general ability (as measured by IQ tests) or the things one has learned at school and motivation to learn (as measured by school grades)? Not many studies have explicitly compared the predictive power of IQ scores and school grades (e.g., Taubman & Wales, 1974, chapter 3). But the more general question about the usefulness of grades as predictors of success has been the object of considerable debate (see Roth, BeVier, Switzer, & Schippmann, 1996; Roth & Clark, 1998). The meta-analysis by Roth and Clark (1998), for instance, found an average correlation of .28 between grades and salary. Thus, contrary to some earlier claims (e.g., McClelland, 1973), grades have turned out to be good predictors of success. This literature is somewhat limited by being almost exclusively restricted to college grades. If the purpose is to compare grades and IQ test scores as predictors of career success, then high school grades would be a better choice because college students constitute a rather selected group that does not represent the full range of career attainments in society. High school grades have been meta-analytically related to job performance (Dye & Reck, 1988) and college grades (Robbins et al., 2004) but there is currently no meta-analysis about the relationship between high school grades and general socioeconomic success (as measured by education, occupation, and income). The present paper will, thus, conduct such a meta-analysis.

4.3. Moderators of the correlation between intelligence and success

In order to further clarify the role of intelligence in people's career, the effects of three moderator variables (age at testing, age at success, and year of success) on intelligence–success correlation will be studied. These moderator variables have been analyzed in several studies but with rather conflicting results.

4.3.1. Age at the time of testing

The first moderator analysis concerns age at testing (age of individuals at the time the IQ test was taken) and how it affects the correlation between intelligence and success. Analysis of the effect of age at testing reveals something about the mechanism behind the intelligence–success correlation. If intelligence predicts success irrespective of the age at which it is measured, then there is reason to believe that the differences in people's career success are the result of the stable individual differences measured by IQ tests (Jencks & Phillips, 1999). If however, the predictive power of IQ tests changes with age, then different interpretations are possible depending on how we believe the test score to be affected by genes and environment. According to the standard sociological interpretation, the test scores of older individuals should be more affected by life experiences than the scores of children (because older individuals simply have had more experiences) and consequently, if intelligence tested at an older age should turn out to be a better predictor career success, then it would mean that the test scores probably reflect some career-relevant experiences which the older individuals have had more time to accumulate (Jencks & Phillips, 1999). The other interpretation is based on behavior genetic research which has found that genetic influences on IQ scores increase with age and environmental influences decrease (McCartney, Harris, & Bernieri, 1990); from these results one can conclude that if the test scores of older individuals are better predictors of success, then it can be attributed to the growing effect of some career-relevant genes.[2]

Empirical evidence concerning age at testing is rather contradictory. A study by McCall (1977) found a clear upward trend in the correlations between intelligence and success; that is, correlations grew stronger as age at testing increased. Some of the studies reviewed by Jencks and Phillips (1999) have found a similar trend. The meta-analysis of Bowles et al. (2001), however, found that age at testing has no effect on the association between intelligence and income. Jencks et al. (1979) reached a similar conclusion in their review.

[1] Ganzeboom et al. (1989) analyzed social mobility tables, Mulligan (1999) analyzed bivariate unstandardized regression coefficients; for this paper, however, bivariate *standardized* regression coefficients (i.e., correlations) are needed.

[2] I am grateful to a reviewer for pointing this interpretation out to me.

4.3.2. Age at the measurement of success

A related issue concerns the age of the individuals at the time their career success is measured. According to the so-called gravitational hypothesis, the correlation between intelligence and success should grow stronger as individuals grow older because (as a result of self-selection and competition) individuals "gravitate" towards the positions that correspond to their ability levels as they progress in their careers. This reasoning has been used to support the idea that intellectual differences cumulate over life course and become progressively more important (see Gottfredson, 2003; Wilk & Sackett, 1996). Other researchers have suggested that exactly the opposite is true: the predictive validity of IQ scores should decline as time goes by because less able people have time to accumulate skills to compensate for their initial lack of ability (Ackerman, 1987; Keil & Cortina, 2001). These opposing views can be reconciled by saying that the idea of declining importance of IQ applies to the performance of specific tasks that become automatic after some practice and the idea of growing importance applies complex long term activities, such as attaining and maintaining social status, that never cease to be cognitively demanding. But so far as socioeconomic success can depend on the performance of specific work tasks, the possibility of declining validity of IQ is not completely ruled out.

Several studies have correlated intelligence with success at different points in people's life course. Some of them have found that the correlations indeed increase with age as predicted by the gravitational hypothesis (Brown & Reynolds, 1975; Deary et al., 2005; Wilk & Sackett, 1996), others have found no clear trend (Hauser, Warren, Huang, & Carter, 1996; Warren, Sheridan, & Hauser, 2002). The reviews by Hulin, Henry, and Noon (1990) and Keil and Cortina (2001) found support for the declining validity thesis but it should be noted that many of the studies reviewed in these papers used specific laboratory tasks as dependent variables and are, therefore, not directly comparable to the studies reviewed in the present paper.

4.3.3. Year of the measurement of success

A particularly controversial issue concerns the historical changes in the relationship between intelligence and success. It was one of the central claims of The Bell Curve that the association between mental ability and career success in western societies has been growing throughout the 20th century (Herrnstein & Murray, 1994). The logic behind this idea is similar to the gravitational hypothesis, discussed in the previous section – in both cases individuals are increasingly drawn towards the positions that correspond to their ability as time goes by – but in this case the gravitation does not take place during a life course of a single individual but over several generations.

Several studies have investigated changes in the association between intelligence and success during past decades. Although Herrnstein and Murray concluded that "*the main point seems beyond dispute*" (1994: 52) and some studies have found support for this point (Murnane, Willett, & Levy, 1995), there are still serious reasons to doubt that the importance of intelligence is or has been growing. Neither the meta-analysis by Bowles et al. (2001) nor the review by Jencks et al. (1979) found any clear trend in the correlations between intelligence and success. The same conclusion was reached by Flynn (2004) and Hauser and Huang (1997). Breen and Goldthorpe (2001) found that the association between intelligence and occupational status in England is, if anything, declining.

5. Method

5.1. Definition of variables

The present meta-analysis investigated the relationship between three measures of socioeconomic success (educational level, occupational level, and income) and three predictors (intelligence, parental SES, and academic performance). The operationalization of these variables is described next.

5.1.1. Socioeconomic success

Educational level was measured by the number of years spent in full time education or the highest level of education completed. Occupational level was typically measured by such occupational scales as Duncan Socioeconomic Index, International Socioeconomic Index of Occupational Status, NORC prestige scale, etc. These scales provide detailed numerical measures of occupational status (see Ganzeboom & Treiman, 1996a, for a general discussion). In some studies, less detailed occupational classifications were used. Irrespective of the level of detail, all the occupational variables in this paper had a common property of ordering occupations on a single hierarchical dimension with higher values designating more desirable and prestigious occupations. Income was measured by salary or total monetary income, which had to refer to the personal income of an individual, not to family or household income. If possible, I preferred income measured on a logarithmic scale because logarithmic transformation removes the skew typically found in income distribution.

5.1.2. Intelligence

Intelligence, or general mental ability, of an individual was measured by a score on a test of intelligence. It is not always easy, however, to decide if a given test is a test of intelligence. The definitions of intelligence state that it is an abstract ability that is not tied to any specific domain of knowledge. Therefore, only the tests that are designed to measure such ability should be used in the meta-analysis. If we take the traditional threefold distinction between ability, aptitude, and achievement tests (Jensen, 1981), then the present study should use only ability and aptitude test scores. Although some researchers have contended that achievement tests can also be treated as measures of general ability (Boudreau, Boswell, Judge, & Bretz, 2001), and even everyday life can be interpreted as an IQ test (Gordon, 1997), the present study took a more conservative approach and included only those tests that are generally regarded as tests of intelligence (see e.g., Anastasi & Urbina, 1997; Jensen, 1980, chapter 7, for a discussion and classification of different tests).

There are numerous "classical" tests (e.g., Henmon–Nelson, Lorge–Thorndike, Otis–Lennon, Raven Progressive Matrices, Stanford–Binet, Wechsler tests) for which there seems to be a general consensus that these are indeed tests of general mental ability. Such multiple aptitude test batteries as Armed Services Vocational Aptitude Battery or General Aptitude Test Battery are also often treated as measures of general ability. The most problematic ones are the tests that are specifically constructed for use in a single data set. Such unique tests have been used in several large and influential data sets (e.g., National Child Development Study, National Longitudinal Survey of High School Class 1972, Panel Study of Income Dynamics, Project Talent). In these cases I consulted the manuals of the data sets and studies that are based on the data. If the test was derived from other IQ tests or if it was described as a test of intelligence, then I included it in my study. Studies using well-known achievement tests, such as Iowa Test of Basic Skills (Smokowski, Mann, Reynolds, & Fraser, 2004), were excluded. The names of all the IQ tests used in this paper are listed in the Appendix.

5.1.3. Parental SES

Five measures of parental socioeconomic status (SES) were used in this paper; the first four were father's education, mother's education, father's occupation, and parental income. The measurement of these variables was similar to the measurement of respondent's own education, occupation, and income (see above). Parental income refers to father's income or total income of parents. Because too few studies reported data on mother's occupation, this variable was not included. In addition to these four, I also used a general index of SES, which combines several parental characteristics into one variable. A number of studies have used a composite index on the assumption that it is a better indicator of social advantages than any of the single variables that make up the index and, therefore, also a better predictor of success (see White, 1982, for supporting evidence). A correlation with SES index was included in the present meta-analysis if the index was composed of the following components — parental education (education of one or both parents), parental occupation (occupation of one or both parents), and material well-being of the parental home. The latter was measured by parental income or by a "possession index" which indicates how many of the valued items (e.g., a car, TV set, computer) were present at home. If a study did not use an index of SES but presented intercorrelations among the necessary variables, then I used the formulas reported by Hunter and Schmidt (2004: 433) to calculate a composite score correlation between SES index and success.

5.1.4. Academic performance

Academic performance was in most studies measured by a grade point average (GPA) obtained in high school or the years preceding high school. In some studies, rank in class (i.e., how well the student performed in comparison with other students in the class) was used instead of GPA. Rank is generally used interchangeably with GPA (see Kuncel, Crede, & Thomas, 2005), therefore, these studies were also included.

5.2. Collection of data

Studies were identified for inclusion in the meta-analysis by searching computerized databases (such as JSTOR, PsycINFO) using terms like "status attainment", "educational attainment" "occupational attainment", "socioeconomic achievement" as keywords. Reference sections of review papers were also searched.

To be included in the meta-analysis, the following general criteria had to be met. First, the measurement of the variables had to correspond to the descriptions presented in Section 5.1. Second, the data had to be longitudinal; that is, the predictors (intelligence, parental SES, and academic performance) had to be measured at an earlier time and career success (education, occupation,

and income) at a later time.[3] Third, the interval between the measurement of predictors and dependent variables had to be at least 3 years because studies with shorter intervals would have very little advantage over cross-sectional studies. Fourth, the study had to report a zero-order correlation between the variables and another measure of association transformable into a zero-order correlation.

Fifth, majority of individuals in the sample had to be at least 20 years old at the time the career success was measured because it makes little sense to talk about the career success of individuals younger than 20. Sixth, majority of individuals had to be less than 25 years old at the time the IQ test was taken because, to properly investigate the effect of intelligence on career, intelligence should be tested before the individuals start a career. Obviously, even individuals tested in their early twenties might already have started a career, but since these individuals can be used for comparison with younger individuals, they were included. Information on parental SES and academic performance had to refer to the time the respondents were approximately 12–18 years old (the time these variables presumably have their greatest impact on subsequent career). Seventh, the study had to be conducted in a "western" society; that is, in the United States, Canada, Europe, Australia, or New Zealand. Additional criteria are described in Section 5.4.

It is rather common for published studies not to report the information necessary for meta-analysis (the lack of zero-order correlations is a typical problem). But fortunately, the raw data of several well-known data sets (e.g., General Social Survey, National Longitudinal Survey of Youth) are available for public use. Because it would be a serious waste of information to leave these sources unused, I decided to use the available raw data to calculate the correlations if none of the published sources reported the necessary information or if the information in the published source was deficient in some way (e.g., if the correlations were reported separately for men and women but not for the complete sample). Most of the raw data sets had been prepared for public use and contained all the necessary variables in a ready-to-use form. In some cases, minor statistical procedures were implemented before calculating the correlations (e.g., summing the standardized scores of subtests to obtain the score of general intelligence; transforming the original occupational variable into a more appropriate prestige scale using the methodological tools provided by Ganzeboom and Treiman (1996b). The raw data sets used in this paper are listed in the Appendix.

Several longitudinal data sets contain data from more than one follow up. Career success has been measured repeatedly for the same individuals in these data sets (up to 20 times in some cases). In some data sets, the predictors (intelligence, parental SES, or academic performance) have also been measured repeatedly. In order to ascertain that every sample contributed only one correlation to one analysis, I averaged all the correlations that were derived from the same sample. If the sample sizes of the averaged correlations were different, mean sample size was used. The procedures for moderator analyses are described in Sections 6.3 and 6.4.

5.3. Correcting for unreliability

Ideally, every correlation should be corrected with the reliability coefficients obtained from the same sample as the correlation that needs to be corrected (Hunter & Schmidt, 2004, chapter 3). However, such reliability coefficients were available for only a small minority of studies included in the present meta-analysis. The correlations from these studies were corrected with these reliability coefficients. But for the majority of studies, mean reliabilities (estimated from various sources, as described below) were used. Each study was then corrected individually with the appropriate reliability coefficient. The nature and sources of reliability information are described next.

5.3.1. Socioeconomic success

Information on education, occupation, and income can be obtained from three sources. The first source is institutional record (e.g., tax records of income). Following the common practice, data from such objective sources were assumed to have a reliability of 1. The second and by far the most common source is self-report. Self-reports are not perfectly reliable, however. The amount of error is usually measured by asking the same individuals to report their socioeconomic characteristics again after a few months and then correlating the first and second reports (producing a test–retest

[3] That does not mean that all the studies had to actually include at least two waves of measurement because one of the predictors, parental SES, can be measured retrospectively (by asking adult respondents questions like "what was your father's occupation at the time you were 16?"). It is important, however, that the information about father's occupation or parental income obtained from adult respondents refers to parents' *past* (not current) occupation or income. The latter requirement was not applied to parental education because parents' education is unlikely to change while children grow up. In some studies (e.g. Duncan & Hodge, 1963), father's occupation was rather vaguely referred to as father's "usual occupation" or "longest occupation". These studies were also included.

correlation). Several estimates of these correlations, derived from nationally representative samples, are available. Using the data presented by Bowles (1972) and Jencks et al. (1979), I calculated the average test–retest correlations for educational level (.89), occupational status (.88), and income (.83). These values were used to correct the correlations with self-reported socioeconomic success. The third possibility is to obtain the information from the spouse, parent, sibling, or child of the focal individual. Because these sources would introduce unnecessary complications and an unknown degree of error, the studies using these sources were excluded unless they contained correlations between intelligence and success (these correlations are too valuable to be discarded).[4]

5.3.2. Intelligence

When correcting for unreliability in the test scores, test–retest alternate-form reliability (the correlation between parallel forms of the same test administered on two separate occasions) is generally considered to be the most appropriate form of reliability (Schmidt & Hunter, 1999). But since these coefficients are rarely available, simple test–retest reliability is often taken as the second best option in meta-analytic studies of the predictive power of IQ scores (Judge, Colbert, & Ilies, 2004; Salgado, Anderson, Moscoso, Bertua, & Fruyt, 2003). Because test–retest reliability coefficients were reported in only a few studies, an average test–retest coefficient, obtained from the meta-analysis of Salgado et al. (2003), was used for most of the studies. Salgado et al. averaged 31 test–retest correlations of different general mental ability tests (the mean interval between test and retest being 6 months) and obtained an average coefficient of .83. This value is similar to average test–retest correlations obtained in other reviews: e.g., .82 in Parker, Hanson, and Hunsley (1988) or .85 in Kuncel, Hezlett, and Ones (2004). Thus, the reliability of .83 seems to be a representative estimate and was used in the present study.

5.3.3. Parental SES

The information on parental education, occupation, and income can come from three sources. First, it can be reported by the parents themselves. If this was the case, then the correlations were corrected with the same reliability coefficients that were used for self-reported education, occupation, and income. Second, it can be reported by the children. Children's reports on parental characteristics are known to suffer from considerable error. Probably the best estimate of this error is the correlation between child's report and parent's own report on a given characteristic. Looker (1989) has presented a comprehensive review of these correlations for father's education, mother's education, and father's occupation. Using the information in Table 3 in Looker's paper, I calculated the average correlations between child's report and parent's report. The average correlations are .80 for father's education, .79 for mother's education, and .78 for father's occupation. These values were used to correct the correlations that involved children's reports on parental SES.[5] Information on the reliability of children's reports on parental income is harder to find. I could locate two studies (Bell, Senese, & Elliott, 1984; Massagli & Hauser, 1983) that provided reliability estimates from three samples. The estimates ranged from .45 to .59. with an average of .51 that was used in the present paper. The third source of information on parental SES is objective data (e.g., tax records of income) that was assumed to have a reliability of 1. Internal consistency method (Cronbach alpha) was used to correct for unreliability in the SES index. This method was recommended by Hunter and Schmidt (2004: 438) for composite variables. For all but two studies, the alpha value of the SES index was obtained from the same sample as the correlation itself. For the remaining two, the average alpha of all the other studies (.71) was used.

5.3.4. Academic performance

If the information on academic performance (GPA or class rank) was obtained from school records, it was assumed to have a reliability of 1. Students' self-reports on their GPA or rank are, of course, not perfectly reliable. The reliability of self-reports is assessed by the correlation between self-reported GPA (or rank) and GPA (or rank) obtained from school records. A recent meta-analysis by Kuncel et al. (2005) found that this correlation is .82 for high school GPA and .77 for high school rank. These values were used to correct the correlations that involved self-reported GPA or rank.

[4] In the study by Vroon, Leeuw, and Meester (1986) the dependent variable (occupation) was reported by the child of the focal respondent. For this study the reliability of children's report on father's occupation was used.

[5] Children's reports on parental SES can further be divided according to the age of the child at the time of reporting. When calculating the average reliabilities from Looker's (1989) data, I excluded the samples of children younger than 9th grade because the reports of such children were not used in the present meta-analysis.

5.4. Correcting for range restriction and dichotomization

No mathematical correction for range restriction was performed in the present meta-analysis. Instead of that, the correction was done indirectly by excluding studies with considerable range restriction. This strategy was preferred because most of the studies that satisfied the inclusion criteria (see Section 5.2) were based on samples that were fairly representative of the general population and did not require the correction for range restriction. It is, therefore, appropriate to limit the current meta-analysis to representative studies and exclude the studies that exhibit signs of considerable range restriction.[6] More specifically, I excluded the studies that sampled only (a) college students or individuals with a college degree (e.g., Eckland, 1965), (b) employees of a single organization (e.g., Dreher & Bretz, 1991), or (c) representatives of one specific occupational group (such as engineers or managers; see e.g., Sackett, Gruys, & Ellingson, 1998).[7] These criteria exclude much of the personnel selection research, which is the kind of research where the problem of range restriction is particularly serious (see Hunter & Schmidt, 2004). I also excluded the correlation if the range of one (or both) of the correlated variables was deliberately restricted by the research design. For example, in the study of gifted children by Terman and Oden (1947), the range of intelligence was severely restricted by sampling only individuals with IQs over 135; in the Polish study by Firkowska-Mankiewicz (2002), the range of intelligence was restricted by sampling only individuals with IQs below 86 or over 130. The correlations obtained from Fergusson, Horwood, and Ridder (2005) and Kuh and Wadsworth (1991) were the only ones that had to be corrected for dichotomization.

5.5. Moderator variables

In order to investigate the issues described in Section 4.3, the following moderator variables were coded for every study: the mean age of the sample at the time of testing, the mean age of the sample at the time of the measurement of success, and the year of the measurement of success. The moderator analyses are meaningful only if every sample, included in a particular analysis, is reasonably homogenous in terms of the moderator variables (i.e., all the individuals in the sample should be of approximately the same age and studied at the same time). To achieve that, I excluded a study from a moderator analysis if the range of the moderator variable in question exceeded 10 years. It should be noted, however, that the majority of the samples that provided data on intelligence were rather homogenous in terms of all the moderator variables because longitudinal surveys typically concentrate on a specific cohort. The moderator analyses were conducted in two steps: first a more conventional subgroup analysis and then a meta-regression analysis. The details of these analyses are described in Sections 6.3 and 6.4.

5.6. Meta-analytic calculations

In order to estimate the strength of the relationship between predictors and success, three averages were calculated: a simple average correlation, a sample size weighted average correlation, and a sample size weighted average correlation corrected for unreliability and dichotomization in the correlated variables. The latter constitutes the central meta-analytic result of the present paper. Other averages can be used for comparison to see how much the results are affected by weighting and correcting the original correlations. Because the sample sizes were highly variable (from 60 to 339,951 with a median of 518), weighting the correlations by sample size would allow the few very large studies to overly dominate the results. To prevent that, all the samples with the size over 7000 individuals (about 5% of the samples in this study) were set equal to 7000 for the weighting procedure.

In order to estimate the variability of the correlations, the standard deviation of original correlations and corrected standard deviation of corrected correlations (Hunter & Schmidt, 2004: 126) were calculated. The 95% credibility intervals of sample size weighted corrected correlations were calculated to assess the presence of moderators. Moderators are present if the credibility intervals are large (over 0.11 according to Koslowsky & Sagie, 1993) or include zero (see Whitener, 1990). Finally, 95% confidence intervals of the sample size weighted corrected correlations were calculated using the formula for heterogeneous studies (Whitener, 1990: 317). Confidence intervals can be used to assess the significance of the correlations (correlation is significantly different from zero if the confidence intervals do

[6] Of course, one cannot expect the samples to be representative in terms of every possible characteristic (such as age, gender, or race). It is enough if the samples are reasonably representative in terms of the variables that are analyzed in the present study.

[7] In a couple of cases, the study itself was based on a representative sample but some of the correlations were regrettably reported only for specific occupational groups (e.g. Thorndike et al., 1934; Thorndike & Hagen, 1959). These correlations were not used.

not include zero) as well as to compare correlations (according to a simple and conservative rule of thumb, two correlations are significantly different from one another if their confidence intervals do not intersect).

6. Results

6.1. The meta-analytic database

Data from 85 data sets (135 samples) were used in the present meta-analysis; 49 data sets (65 samples) provided information on the relationship between intelligence and socioeconomic success. All the data sets used in this paper are listed in the Appendix, detailed information on the data is available at www.zone.ee/tstrenze/meta.xls. The United States is the most important source of data: 36 data sets containing information on intelligence and career success originate from the U.S.A.; United Kingdom is represented by 6 data sets, New Zealand by 2; Australia, Estonia, Netherlands, Norway, and Sweden are all represented by one data set.[8]

6.2. Predictors of socioeconomic success

Table 1 presents the general meta-analytic description of the relationship between predictors and measures of socioeconomic success. The table is divided into three sections with every section presenting the results for one measure of success. It can be observed that, for every predictor, the correlation with education is the strongest one and the correlation with income the weakest one.

The first row in every section of Table 1 presents the general results for intelligence as a predictor of success. The phrase "all studies" in parentheses indicates that all the studies that satisfied the inclusion criteria are included in these analyses. As expected, intelligence is positively correlated with education, occupation, and income; the sample size weighted and corrected correlations (p) are .56, .43, and .20, respectively. The fact that the 95% credibility intervals exceed 0.11 suggests the presence of moderators according to Koslowsky and Sagie (1993). Comparing the three averages (r, rw, and p) in every row to one another demonstrates that weighting the correlations by sample size tends to reduce the average. This means that larger studies produced smaller correlations indicating in turn that smaller, and potentially less representative, samples overestimate the correlation between intelligence and success.

The results, just described, can be criticized for including several samples that are somewhat inappropriate for studying the causal influence of intelligence on success. In some studies, most of the individuals were already in their early twenties at the time the IQ test was taken. It is possible that many individuals in these samples had already started a career by that time, which makes the direction of influence between intelligence and career success rather ambiguous. Furthermore, in several studies the individuals were still in their twenties at the time their career success was measured. It seems reasonable to assume, however, that individuals under 30 cannot yet be reliably classified as more successful or less successful. Taking these observations into account, the second row in every section of Table 1, containing the phrase "best studies" in parentheses, includes only samples with the average age of less than 19 at testing and over 29 at the measurement of success. If raw data were used, then the individuals of inappropriate age were simply excluded.

Looking at the "best studies", we can observe the corrected sample size weighted correlations of .56, .45, and .23 between intelligence and education, occupation, and income, respectively. These correlations can be treated as the most appropriate estimates of the relationship between intelligence and socioeconomic success. The averages of the "best studies" are somewhat higher than the averages of "all studies" indicating that the inclusion of the less appropriate samples among the latter lowers the meta-analytic results. It is surprising how much the number of samples (k) included among the "best studies" differs from the number of "all studies" — almost two thirds of the correlations with education had to be excluded for the analysis of the "best studies". It shows that much of the research on intelligence and success is being conducted with samples that are either too old at the time of testing or too young at the measurement of success.

Having characterized the predictive power of intelligence in general, the next step is to compare it to the predictive power of parental SES and academic performance. Table 1 presents the meta-analytic results for the five indicators of parental SES (father's education, mother's education, father's occupation, parental income, and the SES index). Not surprisingly, all the correlations are positive but, judging by the confidence intervals, several of the correlations (e.g., the one between father's education and education, $p=.50$, or father's occupation and occupation, $p=.35$) are significantly smaller than the respective correlations for intelligence. On the other hand, none of the parental variables is a significantly stronger predictor than intelligence. The SES index is the most successful predictor

[8] Note that these figures apply to the data sets that contain information on intelligence and success. Several additional data sets were used to obtain correlations between parental SES and success or between academic performance and success (see Appendix).

Table 1
Predictors of socioeconomic success

	k	*N*	*r*	rw	*p*	S.D.*r*	S.D.*p*	CV 95%	CI 95%
Correlation with education									
Intelligence (all studies)	59	84,828	.46	.48	.56	.12	.10	.36/.75	.53/.58
Intelligence (best studies)[a]	20	26,504	.49	.48	.56	.10	.07	.42/.69	.52/.59
Father's education	72	156,360	.40	.42	.50	.14	.13	.25/.75	.47/.53
Mother's education	57	141,216	.37	.40	.48	.13	.13	.22/.73	.44/.51
Father's occupation	55	147,090	.34	.35	.42	.09	.07	.27/.56	.40/.44
Parental income	13	64,165	.29	.31	.39	.10	.11	.17/.61	.33/.46
SES index	17	69,082	.41	.44	.55	.12	.10	.35/.75	.50/.60
Academic performance	27	49,646	.48	.47	.53	.09	.07	.39/.68	.50/.56
Correlation with occupation									
Intelligence (all studies)	45	72,290	.37	.36	.43	.13	.08	.28/.57	.40/.45
Intelligence (best studies)[a]	21	43,304	.41	.38	.45	.09	.05	.35/.54	.42/.47
Father's education	52	132,591	.27	.26	.31	.08	.06	.19/.43	.29/.33
Mother's education	40	116,998	.24	.23	.27	.08	.07	.13/.41	.25/.30
Father's occupation	57	146,343	.28	.29	.35	.10	.08	.19/.51	.33/.37
Parental income	12	60,735	.19	.21	.27	.07	.10	.07/.46	.21/.32
SES index	16	74,925	.30	.31	.38	.08	.08	.22/.54	.34/.42
Academic performance	17	54,049	.33	.33	.37	.09	.07	.23/.51	.33/.41
Correlation with income									
Intelligence (all studies)	31	58,758	.21	.16	.20	.09	.11	−.01/.40	.16/.23
Intelligence (best studies)[a]	15	29,152	.22	.19	.23	.08	.06	.10/.35	.19/.26
Father's education	45	107,312	.16	.14	.17	.09	.08	.01/.32	.14/.19
Mother's education	37	93,616	.13	.11	.13	.10	.07	.00/.27	.11/.16
Father's occupation	31	98,812	.16	.15	.19	.08	.10	.00/.38	.15/.22
Parental income	17	395,562	.16	.16	.20	.06	.07	.06/.33	.16/.23
SES index	14	64,711	.15	.14	.18	.07	.08	.03/.33	.14/.22
Academic performance	14	41,937	.11	.08	.09	.07	.08	−.07/.24	.04/.13

Note. *k* — number of independent samples, *N* — number of individuals, *r* — average correlation, rw — sample size weighted average correlation, *p* — sample size weighted average correlation corrected for unreliability and dichotomization, S.D.*r* — standard deviation of *r*, S.D.*p* — corrected standard deviation of *p*, CV 95%–95% credibility intervals of p, CI 95%–95% confidence intervals of *p*, SES — socioeconomic status.
[a]Best studies are the ones where intelligence is tested before the age of 19, and socioeconomic success is measured after the age of 29.

among the parental variables by not being a significantly weaker predictor than intelligence for any of the measures of success.[9]

[9] A reviewer suggested that a useful strategy for comparing the predictive power of two variables would be to look at the samples that provide information on both predictors and then make comparisons within each sample. The advantage of such within-sample comparisons would be the elimination of between-study methodological differences. I used this strategy to compare the correlations with intelligence and SES index (arguably the best measure of social background). The significance of the difference between the correlations was tested with the formula for comparing dependent correlations (Meng, Rosenthal, & Rubin, 1992: 173). With education as the measure of success, there were 15 samples that provided correlations with both IQ and SES index; in 11 of these samples, the correlations were significantly different ($p<.05$, 2-tailed); 8 of the significant differences were in favor of IQ. With occupation as the measure of success, 14 comparisons were made; 7 of the differences were significant, all in favor of IQ. With income as the measure of success, 12 comparisons were made; 5 were significant, 2 of them in favor of IQ. These results suggest that there seems to be an overall tendency for IQ to be a better predictor but this tendency is not consistently found in every occasion.

The results for academic performance are presented in the last rows of the three sections of Table 1. The correlations of academic performance with education ($p=.53$) and occupation ($p=.37$) demonstrate that academic performance is an important predictor of educational and occupational success. The predictive power in relation to income, however, is weak ($p=.09$).

6.3. Moderator analysis using subgroups

As a first step in analyzing the influence of moderator variables, the analysis of subgroups was performed. The moderator variables were divided into the following categories: age at testing into 1–10, 11–15, 16–18, 19–25; age at success into 20–24, 25–29, 30–34, 35–39, 40–44, 45–49, and over 49; and the year of success into pre-1960, 1960–1969, 1970–1979, 1980–1989, post-1989. The raw data sets were exploited to the full extent by dividing the samples into appropriate subgroups by age or year. Every sample

Table 2
Moderators of the correlation between intelligence and socioeconomic success

Moderators	Correlation with education				Correlation with occupation				Correlation with income			
	k	*N*	*r*	*p*	*k*	*N*	*r*	*p*	*k*	*N*	*r*	*p*
Age at testing												
3–10	12	16,330	.37	.42	12	15,083	.37	.35	8	13,614	.19	.20
11–15	26	26,208	.49	.57	16	13,711	.41	.45	6	9911	.23	.24
16–18	22	41,017	.51	.58	19	44,270	.40	.43	13	34,031	.17	.12
19–23	7	11,626	.51	.61	6	7855	.37	.47	7	13,177	.25	.33
Age at success												
20–24	28	50,080	.47	.57	16	41,359	.31	.35	10	30,979	.06	.01
25–29	23	44,253	.48	.57	22	43,559	.40	.44	20	44,521	.16	.20
30–34	14	22,102	.48	.58	15	28,674	.40	.45	16	31,297	.21	.27
35–39	9	13,199	.47	.55	11	13,442	.39	.45	9	8176	.25	.31
40–44	6	5250	.48	.55	8	14,815	.38	.45	7	11,000	.25	.23
45–49	6	4541	.43	.41	5	2036	.39	.46	5	1838	.21	.24
50–78	8	2826	.50	.58	7	5686	.44	.47	4	1137	.24	.25
Year of success												
1929–1959	6	3901	.53	.61	4	991	.48	.44	3	7192	.16	.24
1960–1969	17	28,642	.51	.57	12	23,795	.44	.43	7	11,189	.22	.28
1970–1979	18	30,882	.49	.57	13	24,671	.39	.42	11	17,189	.19	.11
1980–1989	17	27,313	.41	.54	17	24,004	.31	.45	12	25,834	.20	.14
1990–2003	13	28,763	.41	.56	13	38,889	.32	.41	11	31,655	.18	.22

Note. *k* — number of independent samples, *N* — number of individuals, *r* — average correlation, *p* — sample size weighted average correlation corrected for unreliability and dichotomization.

contributed only one correlation to a moderator category. If a sample could contribute more than one correlation, then the most appropriate of the available correlations (the one that best fitted into the moderator category) was used. Equally appropriate correlations were averaged.

Table 2 presents the results of the moderator analysis. The table is divided into three sections with every section presenting the results for one moderator variable. In the first section of Table 2, age at testing (i.e., mean age of the sample at the time of ability testing) is used as a moderator variable. The youngest sample in this analysis was, on average, 3 years old at the time of testing, the oldest one was 23 years old. The results of the analysis are quite clear-cut with regard to education and occupation as measures of success: the correlations increase as age at testing increases. The correlation between intelligence and income does not exhibit any obvious trend but even here the largest correlation comes from the oldest group.

In the next section of Table 2, the moderator variable is age at success (i.e., the mean age of the sample at the time of the measurement of socioeconomic success). Age at success ranges from 20 to 78 in the present study. The results are rather different for different measures of success. The correlation between intelligence and education remains more or less stable. The correlation between intelligence and occupation takes a noticeable upward leap during the twenties – from .35 in the 20–24 group to the .44 in the 25–29 group – and then levels off. The correlation between intelligence and income undergoes the most dramatic changes: the correlation is barely above zero in the 20–24 group but jumps to the value of .20 in the 25–29 group, and then takes another jump to the value of .27 in the 30–34 group; after the age of 40, the correlation appears to decline again but not as low as the values it had before the age of 30.

The influence of the third moderator variable, year of success (i.e., year of the measurement of success), is analyzed in the third section of Table 2. Year of success ranges from 1929 to 2003 in the present meta-analysis. Judging by the sample size weighted corrected correlations (p), there appears to be no historical trend for any one of the moderator variables: correlations with education and occupation remain more or less stable throughout the period under study; correlations with income fluctuate more but without any obvious direction. Quite surprisingly, if unweighted and uncorrected correlations (r) are observed instead, then the

correlations with education and occupation exhibit a declining trend.

6.4. Moderator analysis using multiple regression

Moderator analyses in the previous section can be criticized for ignoring the fact that the moderator variables might not be completely independent of each other, which makes it possible to claim that some of the results can be explained by the intercorrelations among the moderator variables (Steel & Kammeyer-Mueller, 2002). In order to take account of this possibility, I conducted multiple linear regression analyses using the moderator variables as independent variables and the correlations between intelligence and measures of success as dependent variables. Such meta-regression analysis is a common meta-analytic tool (see Ganzeboom et al., 1989; Robbins et al., 2004).

The analyses that follow differ from the preceding moderator analyses in an important respect: in order to use all the available information, I gave up the requirement of independent data and included all the available correlations. If mental ability or socioeconomic success was measured repeatedly for the same sample, then all the correlations were included making it possible for one sample to contribute more than one correlation to the analysis.[10] Naturally, this strategy results in some samples providing much more correlations than others. In order to control for the effects of overrepresented samples, I constructed dummy variables for all the data sets that contributed more than 2 correlations from the same sample to a given moderator analysis. The dummy variables were inserted into regression models as independent variables. In some raw data sets that were large enough, the sample was broken down into smaller samples. For example, the National Longitudinal Survey of Young Women was divided into three subsamples according to the age at the start of the survey – the 14–17, 18–20, and 21–24 year olds – and these subsamples were then used as separate samples in the regression analyses. This was done to obtain samples that are more homogenous in terms of age and year and, thus, to better capture the effects of moderator variables.[11]

Table 3
Regression analyses of the impact of moderator variables on the correlation between intelligence and success

Independent variables	Dependent variables		
	Correlation between intelligence and...		
	Education	Occupation	Income
Age at testing	.49***	.35***	.39***
Age at success	−.11**	.56***	.40***
Year of success	.08*	−.54***	.10
U.S.A. dummy	−.05	−.18	−.16
Raw data dummy	−.23***	.31*	−.23
R^2 adjusted	.79	.47	.65
N	307	256	253

*$p<.05$, **$p<.01$, ***$p<.001$ (2-tailed).

Note. All the regression models include dummy variables for data sets that contribute more than 2 correlations from the same sample; coefficients are standardized regression coefficients; R^2 adjusted — explained variance, N — number of correlations in the analysis.

The results of the meta-regression analyses are presented in Table 3. There are three dependent variables in the table: the uncorrected correlations of intelligence with education, occupation, and income.[12] The independent variables are the three moderator variables (age at testing, age at success, and year of study) and data set dummies. In order to provide a rough control for possible international differences, I also included a dummy variable that equals 1 if the study was conducted in the United States. Furthermore, in order to control for possible methodological differences that might arise from using raw data (see Section 5.3), I constructed a dummy variable that equals 1 if the correlation was calculated from raw data. Following the suggestions made by Steel and Kammeyer-Mueller (2002), weighted least squares regression analysis was used: each correlation was weighted by the inverse of its sampling error variance as described in Steel and Kammeyer-Mueller (2002: 100–101).

[10] In order to understand the necessity of this methodological decision, consider the National Longitudinal Survey of Youth. This data set contains annual or biennial information on the career success of its respondents for a period of more than 20 years, thus providing an ideal opportunity to study age-related and historical changes in the relationship between intelligence and career. All this information would be lost, however, if only one correlation was allowed to represent one sample.

[11] There is, of course, a threat that breaking the original sample into smaller samples might limit the variance of the variables. But this is unlikely to be the case because all these newly created subsamples were large enough (sample size ranged from 126 to 4385 with a median of 503) to prevent any serious restriction of variance.

[12] It would make very little difference if *corrected* correlations (rather than uncorrected ones) were used in these analyses because almost all correlations would be corrected with the same reliability coefficients (see Section 5.3) and would, thus, be equally affected by the correction.

The results of the meta-regression analysis in Table 3 are not radically different from the results of the previous moderator analysis in Table 2. The moderating effect of age at testing is positive and significant in all the three regression models. Age at success has a positive effect on the correlations with occupation and income and a weak negative effect of the correlation with education. Year of success provides some surprises by having a weak positive effect of the correlation with education and a strong negative effect on the correlation with occupation. It is of interest that the U.S.A. dummy is not significant in any of the regression models indicating that the effect of IQ in the United States is similar to its effect in other western societies. The raw data dummy has a highly significant negative effect on the correlation with education and a barely significant positive effect on the correlation with occupation. Therefore, it seems that the inclusion of raw data is more likely to introduce a downward (rather than upward) bias into the meta-analysis thus making the results conservative.

7. Discussion

7.1. Intelligence as a predictor of socioeconomic success

Intelligence plays an influential and yet controversial role in people's career (Gottfredson, 1997). In order to investigate this role, the relationship between intelligence and socioeconomic success was analyzed using meta-analytic techniques. The first aim of the paper was to estimate the strength of this relationship. The overall correlations were .56 (between intelligence and education), .43 (between intelligence and occupation), and .20 (between intelligence and income). Exclusion of the samples that were too old (over 18) at the time of testing or too young (below 30) at the measurement of success resulted in somewhat larger correlations: .56, .45, and .23, respectively. These results demonstrate that intelligence, when it is measured before most individuals have finished their schooling, is a powerful predictor of career success 12 or more years later when most individuals have already entered stable careers. Two of the correlations – with education and occupation – are of substantial magnitude according to the usual standards of social science (Cohen, 1988); the correlation with education even surpasses the well-established correlation of .51 between intelligence and job performance (Schmidt & Hunter, 1998). The correlation with income is considerably lower, perhaps even disappointingly low, being about the average of the previous meta-analytic estimates (.15 by Bowles et al., 2001; and .27 by Ng et al., 2005). But it should be noted that other predictors, studied in this paper, are not doing any better in predicting income, which demonstrates that financial success is difficult to predict by any variable. This claim is further corroborated by the meta-analysis of Ng et al. (2005) where the best predictor of salary was educational level with a correlation of only .29. It should also be noted that the correlation of .23 is about the size of the average meta-analytic result in psychology (Hemphill, 2003) and cannot, therefore, be treated as insignificant.

The second aim of the meta-analysis was to compare the predictive power of intelligence to the predictive power of other prominent predictors of success, parental SES and academic performance. Such comparisons are informative because different predictors represent different paths to a successful career: intelligence represents one's general ability, parental SES represents the social advantages or disadvantages experienced by a person, and academic performance represents school-related learning and motivation. Meta-analysis demonstrated that parental SES and academic performance are indeed positively related to career success but the predictive power of these variables is not stronger than that of intelligence (see Table 1). In fact, intelligence exhibited several correlations with the measures of success that were larger than the respective correlations for other predictors suggesting that intelligence is, after all, a better predictor of success. Still, the differences in favor of intelligence were not as overwhelming as one would have expected based on the results of Herrnstein and Murray (1994). The index of parental SES, arguably the most representative measure of social background, did not differ significantly from intelligence in its predictive power (see Table 1). The same is true about the predictive power of academic performance in relation to education and occupation.

It has been observed before that meta-analyses typically do not provide support for extreme scientific positions (Lytton & Romney, 1991). This is also true in the present case because the extreme positions favoring intelligence (Herrnstein & Murray, 1994) or parental SES (Bowles & Gintis, 1976) were not supported by the results. The reasonable conclusion is rather modest: while intelligence is one of the central determinants of one's socioeconomic success, parental

SES and academic performance also play an important role in the process of status attainment. Despite the modest conclusion, these results are important because they falsify a claim often made by the critics of the "testing movement": that the positive relationship between intelligence and success is just the effect of parental SES or academic performance influencing them both (see Bowles & Gintis, 1976; Fischer et al., 1996; McClelland, 1973). If the correlation between intelligence and success was a mere byproduct of the causal effect of parental SES or academic performance, then parental SES and academic performance should have outcompeted intelligence as predictors of success; but this was clearly not so. These results confirm that intelligence is an independent causal force among the determinants of success; in other words, the fact that intelligent people are successful is not completely explainable by the fact that intelligent people have wealthy parents and are doing better at school.

A number of moderator analyses of the intelligence–success correlation were also performed with the aim of further clarifying the relationship between intelligence and success. The effects of three moderator variables – age at testing, age at success, and year of success – were analyzed. With regard to age at testing, the results in Tables 2 and 3 clearly demonstrate that the test scores of older individuals are better predictors of success than the scores of younger individuals. As discussed in Section 4.3.1, there are two conflicting explanations for this result. On the one hand, if we assume that the test scores of older individuals are more "contaminated" by experiences, then this result suggests that experiences make a contribution to the correlation between intelligence and success. But on the other hand, if we assume that the test scores of older individuals are more "contaminated" by genetic influences, then it would mean that genes make a contribution to this correlation. Yet another explanation would be that IQ scores of children are simply less reliable and the predictive validity of childhood IQ was, therefore, underestimated. But contrary to this explanation, preliminary examination of some evidence on the stability of intelligence among children (e.g., Burchinal, Campbell, Bryant, Wasik, & Ramey, 1997; Jensen, 1980: 279) suggested that the test–retest coefficients among children below 10 are, on the whole, rather similar to the test–retest coefficients among older individuals. It appears that the age-related changes in the predictive validity of test scores cannot be explained by differential reliability of the scores.

Analyses of age at success in Tables 2 and 3 demonstrate that correlations with occupation and income grow stronger as individuals grow older. This result confirms the ideas of the gravitational hypothesis about intellectual differences cumulating throughout life course leading people increasingly towards the social positions that correspond to their ability (Gottfredson, 2003). The fact that declining validity hypothesis (Keil & Cortina, 2001) received no support for occupational and income attainment indicates that being successful in these areas is a complex activity that never ceases to be cognitively demanding. But as for educational attainment, the negative impact of age at success on the IQ-education correlation in Table 3 provides some support for the declining validity hypothesis and suggests that, in educational career, intellectual differences might indeed become somewhat less important as people get older. The difference between education and other measures of success can be explained by the fact that climbing the educational ladder is, in a sense, easier than climbing the occupational or financial ladder (because once you have acquired a certain level of education, you can never loose it again, which is clearly not the case with occupation or income).

Year of the measurement of success had no obvious effect on the corrected correlations (p) between intelligence and success in Table 2. The meta-regression analysis in Table 3 showed that there is a slight tendency for correlation between intelligence and education to increase over the years. This is the only bit of evidence there is to support the claims of Herrnstein and Murray (1994) about the growing importance of mental ability and increasing cognitive stratification. This evidence is rather weak in comparison with the much stronger declining trend exhibited by the correlation with occupation in Table 3. It would be difficult to come up with explanations why intelligence might have become more important with respect to one criterion and less important with respect to another. Therefore, the safest conclusion from Tables 2 and 3 seems to be that the correlation between intelligence and success has not changed in any consistent direction over the past decades. It should be noted that the present paper analyzed changes in the *absolute* importance of intelligence (measured by zero-order correlations); the results so far discussed do not exclude the possibility of growing *relative* importance of intelligence (i.e., importance relative to other predictors). However, the analyses of Bowles et al. (2001) and

Hauser and Huang (1997) found no evidence of any trend in the relative importance.

7.2. Possible limitations and implications for future research

Like all research, the present meta-analysis contains several limitations that can be amended in future research. One limitation concerns the meta-analytic database. Although the present meta-analysis is, to my knowledge, the most comprehensive review of the longitudinal research on intelligence and socioeconomic success, it does not cover all the existing data. I am aware of several additional longitudinal data sets that contain information on intelligence and success but from which I have been unable to obtain necessary data (see Jæger & Holm, 2003; Meghir & Palme, 2005; Nyborg & Jensen, 2001; Scarr & Weinberg, 1994). There are probably others. Efforts to collect information about the existing data sets should be continued. This applies especially to the data from outside the United States because U.S. data were clearly overrepresented in the present paper (see Section 6.1). Lack of data from continental Europe (e.g., Germany or France) demonstrates that intelligence as a scientific construct is primarily an Anglo-American invention and has not been very enthusiastically accepted in other scientific cultures. Of course, intelligence has been studied in continental Europe (see e.g., Flynn, 1987; Sternberg, 2004; Weinert & Schneider, 1999) but I have not been able to find suitable data for the present study.

The present study can also be criticized for underestimating the importance of the predictors of success; arguments can be offered for any of the three predictors (intelligence, parental SES, or academic performance) as to why their importance was underestimated. First, the present study used only three measures of social background (parental education, occupation, and income) and therefore, could have underestimated its importance. Although these three have always been the central indicators of social advantages, several additional measures of social background could have an independent effect on career success (Fischer et al., 1996). Future meta-analyses could, therefore, benefit from considering other variables, such as neighborhood quality (Leventhal & Brooks-Gunn, 2000), number of siblings (Blake, 1989), or parental divorce (Amato & Keith, 1991), to get a more comprehensive picture of the effects of social background. Second, the use of grade point average and class rank as the only measures of academic performance can be criticized for ignoring between-school differences; i.e., the same average grade or rank can have different meanings in different schools depending on the quality of the schools (Bassiri & Schulz, 2003). A more comprehensive study of the importance of academic performance should, therefore, also take account of the quality of the school the individual is attending. Third, as already discussed in Section 7.1, the predictive power of intelligence in younger samples could have been underestimated by using a single test–retest reliability coefficient for all studies that did not provide reliability coefficients of their own. Although it was concluded above that the underestimation was minimal, it would still be desirable to pay more attention to this problem in the future research.

As a possible limitation and implication for future research, it should also be noted that one of the big questions that looms behind every paper that deals with intelligence and success, the question of genetic versus environmental influences on IQ and social status, was not directly addressed in this paper. The fact that IQ scores predict socioeconomic success does not, in itself, tell us whether the effect of intelligence can be attributed to genes or environment. On the one hand, there is clear evidence that children's IQ scores are correlated with parental SES (White, 1982), this result together with the fact that parental SES predicts socioeconomic success (see Table 1) can be interpreted as showing that environment is the "final cause" of one's success or failure. This conclusion has been criticized for ignoring the genetic influences on parental SES (Jensen, 1998). On the other hand, the evidence on the heritability of intelligence (Devlin, Daniels, & Roeder, 1997) and socioeconomic success (Rowe, Vesterdal, & Rodgers, 1999) together with the evidence on the relationship between intelligence and success (see Table 1) can be taken as proof that parents' and children's social status are both determined by the genes for intelligence that run in the family. This conclusion has been challenged by Bowles and Gintis (2002) who argued that, although socioeconomic success might be heritable, the genetic inheritance of IQ, in particular, plays only a very minor part in this process. The results of the present meta-analysis, although not directly addressing these issues, can be useful in these discussions if combined with the results from other studies.

Appendix A

Data sets used in the meta-analysis

Data set[a]	Country	Source(s)[b]	Test(s)[c]	Correlation[d] between IQ and			Data on	
				Education	Occupation	Income	SES[e]	GPA[f]
Albany–Schenectady–Troy sample	U.S.A.	Lai, Lin, and Leung (1998)	–	–	–	–	Yes	No
Annual Twins Day sample	U.S.A.	Ashenfelter and Krueger (1994)	–	–	–	–	Yes	No
Australian sample, 1965	Australia	Lancaster Jones (1971)	–	–	–	–	Yes	No
Australian sample, 1967	Australia	Lancaster Jones (1971)	–	–	–	–	Yes	No
Australian sample, 1977								
Australians	Australia	Marjoribanks (1989)	Raven Progressive Matrices	.29	.28	–	No	No
Creeks	Australia	Marjoribanks (1989)	Raven Progressive Matrices	.39	.38	–	No	No
Italians	Australia	Marjoribanks (1989)	Raven Progressive Matrices	.53	.47	–	No	No
Baltimore Study	U.S.A.	raw data (www.pop.upenn.edu/baltimore)	Peabody Picture Vocabulary Test	.20	.13	.28	No	No
Berkley longitudinal studies								
All	U.S.A.	Elder (1974); Judge, Higgins, Thorensen, and Barrick (1999)	Stanford–Binet, Wechsler–Bellevue	–	.42	.31	No	No
Men	U.S.A.	Clausen (1991); Elder (1974)	Stanford–Binet, Wechsler–Bellevue	.53	–	–	No	No
Women	U.S.A.	Clausen (1991)	Stanford–Binet, Wechsler–Bellevue	.52	–	–	No	No
Bloomington sample								
1918 sample	U.S.A.	Ball (1938)	Mental Survey Test	–	.71	–	No	No
1923 sample	U.S.A.	Ball (1938)	Mental Survey Test	–	.57	–	No	No
British 1970 Cohort Study	U.K.	raw data (www.esds.ac.uk); Bynner (1970)	Human Figure Drawing + English Picture Vocabulary + Profile Test + Copying Design Test; British Ability Scales	.32	.28	.16	Yes	Yes
British sample, 1963	U.K.	Treiman and Terrell (1975a)	–	–	–	–	Yes	No
Canadian income tax data	Canada	Corak and Heisz (1999)	–	–	–	–	Yes	No
Canadian sample, 1975	Canada	Looker and Pineo (1983)	–	–	–	–	Yes	Yes
Christchurch Health and Development Study	New Zealand	Fergusson et al. (2005)	Wechsler Intelligence Scale for Children- Revised	.41	–	.12	No	No
Coleman's sample	U.S.A.	Marini (1984)	Standard Intelligence Scale	.51	–	–	Yes	Yes
Connecticut sample	U.S.A.	Rogers (1969)	several IQ tests	.53	–	.25	No	No
Core City sample	U.S.A.	Vaillant and Vaillant (1981), Long and Vaillant (1984)	Wechsler–Bellevue test	–	.34	.23	No	No
Dunedin Multidisciplinary Health and Development Study	New Zealand	Jaffee (2002)	Wechsler Intelligence Scale for Children- Revised	–	.41	–	No	No
European Social Survey, 2004	17 E.U. countries	raw data (www.europeansocialsurvey.org); Jowell and the Central Co-ordinating Team (2004)	–	–	–	–	Yes	No

Explorations in Equality of Opportunity	U.S.A.	Otto and Haller (1979)	Academic Aptitude test	.48	.35	.07	Yes	Yes
Fels Longitudinal Study								
Men	U.S.A.	McCall (1977)	Stanford–Binet; Wechsler–Bellevue; Primary Mental Abilities	.35	.38	–	Yes	No
Women	U.S.A.	McCall (1977)	Stanford–Binet; Wechsler–Bellevue; Primary Mental Abilities	.46	.49	–	Yes	No
Fort Wayne samples								
1963 seniors	U.S.A.	Kerckhoff (1974)	Lorge–Thorndike	.51	–	–	Yes	No
1969 9th graders, black	U.S.A.	Kerckhoff and Campbell (1977)	Lorge–Thorndike	.52	–	–	Yes	Yes
1969 9th graders, white	U.S.A.	Kerckhoff and Campbell (1977)	Lorge–Thorndike	.54	–	–	Yes	Yes
General Household Survey	U.K.	Psacharopoulos (1977)	–	–	–	–	Yes	No
General Social Survey	U.S.A.	raw data (www.norc.org/projects/gensoc.asp)	–	–	–	–	Yes	No
German Socio-Economic Panel	Germany	Couch and Dunn (1997)	–	–	–	–	Yes	No
Hawaii Family Study of Cognition								
European males	U.S.A.	Nagoshi, Johnson, and Honbo(1993)	15 tests of cognitive abilities	.31	.19	.35	No	No
European females	U.S.A.	Nagoshi et al. (1993)	15 tests of cognitive abilities	.34	.10	.21	No	No
Japanese males	U.S.A.	Nagoshi et al. (1993)	15 tests of cognitive abilities	.35	.25	.28	No	No
Japanese females	U.S.A.	Nagoshi et al. (1993)	15 tests of cognitive abilities	.37	.04	.16	No	No
High School and Beyond, sophmores	U.S.A.	Jencks and Phillips (1999), raw data (nces.ed.gov/surveys)	math+vocabulary+reading test	.55	.41	.09	Yes	Yes
Individual Development and Adaptation	Sweden	Kokko, Bergman, and Pulkkinen (2003)	–	–	–	–	No	Yes
Jyvaskyla Longitudinal Study	Finland	Kokko et al. (2003)	–	–	–	–	No	Yes
Kalamazoo brothers	U.S.A.	Jencks et al. (1979)	Terman, Otis	.58	.36	.37	Yes	No
Kalamazoo Fertility Study	U.S.A.	Bajema (1968)	Terman Group Intelligence Test	.58	.46	–	No	No
Lenawee County Survey	U.S.A.	Otto and Haller (1979)	Cattell IPAT Test	.42	.36	.18	Yes	Yes
Longitudinal Study of Labor Market Experience of Women	U.S.A.	Treiman and Terrell (1975b)	–	–	–	–	Yes	No
Malmö study	Sweden	Jencks et al. (1979)	Hallgren Goup Intelligence Test	.40	.42	.30	No	No
Minneapolis sample	U.S.A.	Benson (1942)	Haggerty Intelligence Examination	.57	–	–	No	No
Minnesota sample								
Fathers	U.S.A.	Waller (1971)	Otis, Kuhlmann	.71	.57	–	No	No
Sons	U.S.A.	Waller (1971)	Otis, Kuhlmann	.52	.50	–	Yes	No
Monitoring the Future project	U.S.A.	Schuster, O'Malley, Bachman, Johnston, and Schulenberg (2001)	–	–	–	–	No	Yes
NAS–NRC veteran twins sample	U.S.A.	Plassman et al. (1995)	Army General Classification Test	.56	–	–	No	No
National Child Development Study	U.K.	raw data (www.esds.ac.uk); City University. Social Statistics Research Unit	general ability test	.44	.38	.18	Yes	No
National Education Longitudinal Study	U.S.A.	raw data (nces.ed.gov/surveys)	–	–	–	–	Yes	Yes
National Longitudinal Survey of 1972 Class	U.S.A.	raw data (nces.ed.gov/surveys)	vocabulary+picture number+reading+letter groups+math+ mosaic comparison	.48	.34	.04	Yes	Yes

(continued on next page)

Appendix A (*continued*)

Data set[a]	Country	Source(s)[b]	Test(s)[c]	Correlation[d] between IQ and			Data on	
				Education	Occupation	Income	SES[e]	GPA[f]
National Longitudinal Survey of Older Men	U.S.A.	Jencks et al. (1979)	–	–	–	–	Yes	No
National Longitudinal Survey of Young Men	U.S.A.	raw data (www.bls.gov/nls)	Otis, Beta, Gamma, California Test of Mental Maturity, Lorge–Thorndike, Henmon–Nelson, Test of Educational Ability, Primary Mental Ability Test, Differential Aptitude Test, School and College Ability Test	.52	.38	.09	Yes	Yes
National Longitudinal Survey of Young Women	U.S.A.	raw data (www.bls.gov/nls)	same as previous	.45	.38	.15	Yes	Yes
National Longitudinal Survey of Youth, 1979	U.S.A.	raw data (www.bls.gov/nls)	California Test of Mental Maturity, Otis–Lennon, Loge–Thorndike, Henmon–Nelson, Kuhlmann–Anderson, Differential Aptitude Test, School and College Ability Test, Stanford–Binet, Wechsler; Armed Forces Qualification Test	.54	.39	.24	Yes	No
National Longitudinal Survey of Youth, 1997	U.S.A.	raw data (www.bls.gov/nls)	Armed Services Vocational Aptitude Battery math-verbal score	.56	.24	.07	Yes	Yes
National Research Program of the Labor Market	Netherlands	De Graaf and Flap (1988)	–	–	–	–	Yes	No
National Survey of Health and Development	U.K.	Kerckhoff (1974); Kuh and Wadsworth (1991); Richards and Sacker (2003)	sentence completion + reading + vocabulary + picture intelligence; Alice Heim	.50	.41	.22	Yes	No
NBER Thorndike–Hagen sample	U.S.A.	Hause (1972)	17 tests of cognitive abilities	.26	–	–	No	No
Negotiating the Lifecourse Project	Australia	Jones and McMillan (2001)	–	–	–	–	Yes	No
Netherlands army sample	Netherlands	Vroon et al. (1986)	Raven Progressive Matrices	–	.42	–	No	No
New York State sample	U.S.A.	Kandel, Chen, and Gill (1995)	–	–	–	–	No	Yes
NLSY79 Child Surveys	U.S.A.	raw data (www.bls.gov/nls)	Digit Span + Peabody Picture Vocabulary Test	.40	.25	.14	Yes	Yes
NORC Brothers	U.S.A.	Jencks et al. (1979)	–	–	–	–	Yes	No
North Ireland sample	U.K.	Cassidy and Lynn (1991)	Differential Aptitude Test	.40	.24	–	Yes	No
Norwegian Twin Panel	Norway	Heath et al. (1985); Tambs, Sundet, Magnus, and Berg (1989)	general ability level	.53	.33	–	Yes	No
Occupational Changes in a Generation	U.S.A.	Jencks et al. (1979)	–	–	–	–	Yes	No
Occupational Changes in a Generation II	U.S.A.	Jencks et al. (1979)	–	–	–	–	Yes	No
Oxford Mobility Project	U.K.	Heath (1981)	–	–	–	–	Yes	No
Panel Study of Income Dynamics	U.S.A.	Couch and Dunn (1997); Jencks et al. (1979), Solon (1992), raw data (psidonline.isr.umich.edu)	Sentence Completion Test	.45	.27	.20	Yes	No

Parent–Child Project	U.S.A.	Englund, Luckner and Whaley (2003)	Wechsler Intelligence Scale for Children Revised	.33	–	–	No	No
Paths of a Generation	Estonia	raw data (psych.ut.ee/esta)	General Aptitude Test Battery	.46	.38	.20	Yes	Yes
Pennsylvania sample	U.S.A.	Chand, Crider and Willits (1983); Hanson (1983)	–	–	–	–	Yes	Yes
Perry Preschool project	U.S.A.	Luster and McAdoo (1996)	Stanford–Binet	.41	–	–	Yes	No
Philadelphia sample	U.S.A.	Thornberry and Farnworth (1982)	–	–	–	–	Yes	No
Poverty of the City of York	U.K.	Atkinson (1981)	–	–	–	–	Yes	No
Productive Americans	U.S.A.	Jencks et al. (1979)	–	–	–	–	Yes	No
Project Talent								
Brothers sample	U.S.A.	Jencks et al. (1979)	Academic Composite	.63	.48	.36	Yes	No
General sample	U.S.A.	Jencks et al. (1979); Jencks, Crouse and Mueser (1983); Porter (1974)	Academic Composite	.52	.40	.20	Yes	Yes
Twins sample	U.S.A.	Jencks et al. (1979)	Academic Composite	.62	–	–	No	No
Scottish Mental Surveys								
1921 cohort	U.K.	Bain et al. (2003); Deary et al. (2005)	Moray House Test	.24	.52	–	No	No
1936 cohort	U.K.	Hope (1983)	Terman–Merrill	.72	.64	–	No	No
Six City Survey of Labor Mobility	U.S.A.	Duncan and Hodge (1963)	–	–	–	–	Yes	No
Social Security earnings records	U.S.A.	Mazumder (2005)	–	–	–	–	Yes	No
Southern Regional Research Project	U.S.A.	Dyk and Wilson (1999); Wilson and Peterson (1993)	Otis–Lennon	.18	.17	–	Yes	Yes
Stockholm sample	Sweden	Gustaffson (1994)	–	–	–	–	Yes	No
Survey of Income and Program Participation	U.S.A.	Hauser, Warren, Huang, and Carter (2000)	–	–	–	–	Yes	No
Thorndike's study								
Boys age group	U.S.A.	Thorndike et al. (1934)	Thorndike–McCall Reading Test+ arithmetical problems	.54	–	–	No	Yes
Boys grade group	U.S.A.	Lorge (1945), Thorndike et al. (1934)	Thorndike–McCall Reading Test+ arithmetical problems	.39	–	–	No	Yes
Girls age group	U.S.A.	Thorndike et al. (1934)	Thorndike–McCall Reading Test+ arithmetical problems	.63	–	–	No	Yes
Girls grade group	U.S.A.	Thorndike et al. (1934)	Thorndike–McCall Reading Test+ arithmetical problems	.50	–	–	No	Yes
Toronto Metropolitan Area sample	Canada	Hagan, MacMillan, and Wheaton (1996)	–	–	–	–	Yes	No
Veterans of Korean War								
Black	U.S.A.	Brown and Reynolds (1975)	Armed Forces Qualification Test	–	–	.10	No	No
White	U.S.A.	Brown and Reynolds (1975)	Armed Forces Qualification Test	–	–	.31	No	No
Veterans sample	U.S.A.	Jencks et al. (1979)	Armed Forces Qualification Test	.55	.38	.35	Yes	No
West Coast high schools	U.S.A.	Spady (1970)	Primary Mental Abilities test	.40	–	–	Yes	Yes
White married women	U.S.A.	Scanzoni (1979)	–	–	–	–	Yes	No

(continued on next page)

Appendix A (*continued*)

Data set[a]	Country	Source(s)[b]	Test(s)[c]	Correlation[d] between IQ and			Data on	
				Education	Occupation	Income	SES[e]	GPA[f]
Wisconsin Longitudinal Survey								
Men	U.S.A.	Hauser et al. (1996), Otto and Haller (1979); Sewell et al. (1970); Sewell, Hauser, and Wolf (1980)	Henmon–Nelson	.48	.39	.16	Yes	Yes
Women	U.S.A.	Hauser et al. (1996), Sewell et al. (1980)	Henmon–Nelson	.35	.35	–	Yes	Yes
Wolfle–Smith sample	U.S.A.	Taubman and Wales (1974)	–	–	–	–	No	Yes
Youth in Transition, Australia	Australia	Marks and Fleming (1998)	–	–	–	–	Yes	No
Youth in Transition, U.S.A.	U.S.A.	Bachmann and O'Malley (1986)	Quick test+General Aptitude Test Battery+Gates test	.58	–	–	Yes	Yes

[a]If possible, the official title of the data set is given; if no official title was reported, the location or the name of the principal author is used to identify the data set.

[b]For several data sets, data were obtained from different sources; all the sources that provided correlations are listed in the Appendix. For every raw data set, a web site address is given where further information about the data is available.

[c]In several data sets, more than one test was used. The tests that were combined into a single measure of intelligence are separated by a plus sign (+); the tests that were administered to different portions of the sample are separated by a comma (,); the tests that were administered in different waves of the longitudinal survey are separated by a semicolon (;).

[d]The uncorrected correlations used in the analysis all studies (see Table 1) are reported in the Appendix. All the correlations reported in the Appendix (or anywhere in the text) were rounded to two decimal places; if more precise values were available, then these values were used in the calculations.

[e]This column indicates if the data set contributed correlations between parental SES and socioeconomic success.

[f]This column indicates if the data set contributed correlations between academic performance and socioeconomic success.

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Allocation of talent in society and its effect on economic development

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ABSTRACT

Several studies in psychology and economics have demonstrated that the average cognitive ability (talent) of people living in a society affects the economic development of the society. There is, however, reason to expect that the economic development of societies depends not just on the average level of talent but also on the allocation of talent in society — societies that allocate people with different talents more efficiently should be more successful in economic terms. Efficient allocation of talent means that people with higher ability do jobs of higher complexity. The present paper constructed several measures of allocation of talent and analyzed their effect on the economic growth rate of countries and U.S. states. Overall, the analyses support the idea that the countries and states that have a better allocation of talent exhibit higher levels of economic growth.

1. Introduction

1.1. Ability of people and wealth of nations

Abilities, skills and talents of people living in a society affect the overall economic development of the society — among psychologists this idea has recently become known through the work of Lynn and Vanhanen (2002, 2006). They have shown that the average IQ scores of people living in different societies (national IQs) are strongly and positively correlated with the level of economic development among these societies. In economics, a similar result has been obtained in the studies of economic growth: the average scores on tests of academic achievement (such as PISA or TIMSS test) are strongly and positively related to the rate of economic growth of the societies (Hanushek & Kimko, 2000; Hanushek & Woessmann, 2008).

Similar ideas are popular outside of academic circles. Politicians in several countries have been concerned about the "talent pool" of their nation. In the United Kingdom, a "review of skills" was ordered by the government with the aim of finding ways to ensure continued prosperity and productivity in Britain; the resulting report proposed that UK should "commit to becoming a world leader in skills" (Leitch, 2006: 3). In the United States, a similar report was commissioned by the Senate and one of the central suggestions of the report was to "increase America's talent pool" (Committee on Science, Engineering, & Public Policy, 2007: 5). In 2001 Michaels, Handfield-Jones and Axelrod published a book called *War for Talent*, which announced that, in today's economy, organizations have to compete for talented employees. Soon after that it was realized that not only organizations but also nations are in a "global war for talent". Nurturing talent in the local population or attracting it from other countries is the key to economic success of a society; emigration of skilled employees (brain drain) is the thing to be avoided (see Brown & Tannock, 2009 for a review).

Evidently, the intellectual capacities of the population are believed to be important for the economic welfare of society. This discourse usually emphasizes the average level of ability (Lynn & Vanhanen, 2002) or the amount of talented people (Rindermann, 2012). But there is another way to approach the issue: instead of the overall *level* of talent or ability, one can look at the *allocation* of talent in society. Given that

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people are not all equal in their talents and abilities, one can ask: how do societies allocate (distribute) people with different abilities? The central hypothesis is: societies that allocate people more efficiently are more successful in economic terms. Thus, even if two societies are equal in terms of the average level of talent, one can still outdo the other if it allocates people more efficiently. Efficient allocation of talent can be defined as a situation where each person performs the task, which he or she is best able to perform. "Task" can mean different things but in contemporary society it mostly means "job" or "occupation". Jobs are also not all equal — some are more cognitively complex than others. Therefore, if people can be measured on a single dimension of ability and jobs can be measured on a single dimension of complexity, then the efficient allocation of talent means that people with higher ability do jobs of higher complexity.

To understand the significance of that imagine a society where the overall level of ability is so high (or the complexity of jobs is so low) that each individual can do *any* job equally well. In this society, people can be allocated to jobs at random. But in real societies there are certainly some jobs that are too complex for some of the people (Gottfredson, 1986a). In that case, it is better to sort people non-randomly, with more talented (intelligent) people getting the more complex jobs. That would maximize the overall output of the national economy. In the words of the Nobel Prize winning economist: "competitive market sorts workers among jobs in a manner that maximizes aggregate output" taking account of "technology and the abilities of individual workers" (Mortensen, 1978: 572). In the case of mismatch between abilities and jobs, some people are allocated to jobs that are too complex for them and some are allocated to jobs that are too simple. It is generally believed that the really grave consequence of mismatch is the allocation of low-ability people to high-complexity jobs (see Handel, 2003). Personnel selection research has consistently shown that cognitive ability scores are stronger predictors of job performance in more complex occupations (Ones, Viswesvaran, & Dilchert, 2005). This means that the recruitment of low-ability people into cognitively complex jobs could result in significantly lowered job performance. The more it can be avoided, the better for the economy.

The present paper is obviously not the first one to come up with such ideas. Already Plato wrote that in an ideal society "each individual should follow, out of the occupations available in the city, the one for which his natural character best fitted him" (Plato, 2000: 127). In more recent times, the idea has surfaced in the functional theory of stratification by Davis and Moore (1945), which stressed the importance of a match between people's talents and their occupational placement for the effective functioning of society. Later, Gottfredson (1986a) developed a more psychological version of the theory by giving the central role to intelligence. She argued that "increasing a match between task complexity and worker intelligence /…/ would increase aggregate economic productivity, perhaps quite substantially" (Gottfredson, 1986a: 397). Thus, several authors have, at different times, suggested that the match between people's talents and job requirements is important for societal development. These suggestions have been mostly theoretical, but there have also been a few attempts at empirical analysis. These will be reviewed in Section 1.3.

1.2. How to measure talent and job complexity?

Three important questions have to be answered: how to measure people's talent, how to measure job complexity and how to measure the match between talent and complexity? The third question will be reserved for the next section but, first, let me comment briefly on the nature of talent and complexity. An important assumption about the talents of people and complexity of jobs is, of course, that both are more or less stable characteristics — if talents could be quickly learned by everyone and job complexities easily manipulated, then the problem of having to match the two would simply not arise. There is plenty of evidence that individual differences in cognitive ability are rather stable (Deary, Whalley, Lemmon, Crawford, & Starr, 2000) and there is no need to go into detailed discussions about the definition and measurement of that ability. It suffices to say that "ability" or "talent" is a bundle of relatively stable cognitive characteristics that can affect job performance.[1] This definition includes general intelligence but excludes job-specific skills — the latter can have a strong impact on job performance but considering that would take us too far from the concerns of the present paper.

Research on the measurement of job complexity has demonstrated that different jobs and occupations can be quite reliably distinguished in terms of the type and level of ability required to perform the job tasks (Campbell, 1988; Gottfredson, 1986a,b). While each job can seem difficult for a novice, some jobs are still "objectively" more cognitively demanding than others, even for experienced workers. For instance, engineer and dentist are cognitively complex jobs, dishwasher and weaver are not so complex (Roos & Treiman, 1980). Likewise, some jobs are more physically complex than others, but physical complexity is probably not so relevant in contemporary world. A few complexity scales have been constructed to measure occupations according to the type and level of required abilities. Probably the best known is the *Dictionary of Occupational Titles* or D.O.T. (Miller, Treiman, Cain, & Roos, 1980). Somewhat different scales have been proposed by Gottfredson (1986b) and Menes (2008).

The problem with these occupational complexity scales is that they are not available in many data sets and, thus, cannot be readily used in empirical research. The researchers interested in job complexity have, therefore, been forced to use wages or other attributes of jobs as proxies for the cognitive complexity of jobs (e.g., Wilk & Sackett, 1996). This is a reasonable strategy because job complexity is positively and strongly correlated with several important attributes of jobs, such as average wages (Menes, 2008; Wilk & Sackett, 1996), prestige and authority (Spaeth, 1979), and education of incumbents (Ganzach, 2003). It can be concluded that wages, prestige and other similar characteristics are reasonably good proxies for job complexity.

1.3. How to measure the allocation of talent in society?

The most important theoretical question for this paper is: how to measure the efficiency of the allocation of talent in

[1] In this paper I will mostly use the term "talent" because this is the term used in much of the literature on the subject. "Allocation of talent" is an established phrase in economics.

society? How to measure the fit between people's ability and job complexity? In this paper I will propose a number of measures and use them to predict the economic development of countries. The measures are based on ideas developed by various authors in different disciplines. I will use several measures (rather than just one) because none of them is ideal: some are plagued by lack of data, others have conceptual problems. But using them together should increase the overall credibility of the analyses. In order to further increase credibility, I will complement the analyses of countries with an analysis of U.S. states. Table 1 lists all the measures of allocation, how these measures are operationalized in this paper and what is their hypothesized effect on economic development.

1.3.1. Measure 1: relationship between ability and job complexity

The most straightforward measure of the allocation of talent in society is the statistical association between people's ability test score and the complexity of their jobs. A positive and strong association indicates that ability is being efficiently allocated (see Section 1.1). Therefore, the stronger the positive association between talent and job complexity in a society, the higher should be the rate of economic development of the society. The challenge for a researcher trying to test this hypothesis is finding suitable data. The data set must include comparable individual level data on people's ability and occupations from different countries. In this paper I will use the only data set that satisfies these conditions (the International Adult Literacy Survey) but even that is far from ideal: the number of countries is small (around 20) and it is not possible to use a direct measure of job complexity (instead I will use wages and occupational group).

I am not aware of any empirical studies that have used the ability–complexity correlation as a predictor of economic development. Nevertheless, quite a few economists have been interested in the allocation of talent in society and its possible effect on economy (Galor & Tsiddon, 1997; Hassler & Mora, 2000; Murphy, Shleifer, & Vishny, 1991; Torvik, 1993). Almost all of the economic studies are, however, purely theoretical, and the conceptualization of "efficient allocation" is somewhat different. At heart of the economic approach is the idea that some activities (jobs) are more productive than others by their nature; the productive activities produce new resources for society, the unproductive ones (also called rent-seeking activities) just redistribute existing resources. The general idea is that talented people should be directed to productive activities; the more society is able to do that, the better off it will be in economic terms.

One of the few studies that has attempted to test this idea empirically is the paper by Murphy et al. (1991). In an analysis of a sample of countries they found that the proportion of students studying engineering (a productive job) has a positive effect on economic growth; proportion of law students, on the other hand, has a negative effect on growth. In another study, Baumol (1990) reviewed several historical examples of how, in economically stagnant periods and regions, unproductive activities like crime, landholding or bureaucratic service have been more profitable and prestigious than productive activities like entrepreneurship or invention. Neither of these studies was able to actually measure people's ability in different activities; their argument was based on a presumption that people with talent can probably be found doing things which promise the highest profit. The present paper will take a different approach by having a direct measure of people's ability. Still, these studies demonstrate that the allocation of talent, as such, is worth being considered as a predictor of economic development.

1.3.2. Measure 2: prevalence of ability testing

The prevalence of ability testing — that is a concise way of saying, how many (what percentage of) organizations in a society use cognitive ability tests for selecting their employees. Ability tests are presumably used by organizations to hire the most suitable job candidates, therefore, the more organizations in a country use ability tests, the greater should be the proportion of people in the workforce that find jobs corresponding to their ability. Given that a tight match of abilities to jobs should be good for economy, the more organizations of a society use ability tests in personnel selection, the higher should be the rate of economic development of the society.

Hunter and Schmidt have been the foremost advocates of the idea that increasing the use of cognitive ability tests in personnel selection could boost the entire national economy (Hunter, 1983; Hunter & Schmidt, 1982, 1996). They published several papers that showed how many dollars the U.S. economy would win if all the workers were hired on the basis of their IQ scores. It is important to notice, however, that Hunter and Schmidt did not conduct a straightforward empirical analysis of the effect of ability testing on economic development; rather, they derived that effect from research conducted for other purposes. To my knowledge, only one study has directly analyzed the influence of the prevalence of

Table 1
Measures of allocation of talent used in this paper.

Measures of allocation of talent	Operationalization of the measures	Unit[a]	Hyp.[b]
Relationship between ability and job complexity	Effect of ability on wages in a country	B	+
	Effect of ability on occupation in a country	B	+
Prevalence of ability testing	Use of ability tests in recruitment in a country (% of organizations)	%	+
	Use of ability tests in recruitment in a country (Ryan et al., 1999)	5-point scale	+
Monetary returns to education	Effect of education on wages in a country	%	+
	Effect of education on wages in a U.S. state	%	+
Monetary rewards in complex occupations	Effect of occupational complexity on occupational wages in a country	B	+

[a] Unit of measurement (see Section 2.1.2 for details): B — unstandardized regression coefficient.
[b] Hypothesized effect on economic development: + positive effect.

ability testing on society's economic development. This is the study by Harville (1997) that found a significant positive relationship between the prevalence of ability testing in the United States and the GDP of USA at the same time, which Harville interpreted as showing that ability testing has, through the years, enhanced the economic growth in the United States. Unfortunately, the study was rather unclear about the analysis and data.

A clear and sensible way to analyze the relationship between the prevalence of ability testing and national economic development is to use data from different countries and use countries as units of analysis. I am not aware of any study that has done that before. There are, however, studies that have done that using organizations as units of analysis. Terpstra and Rozell (1993) found that the service organizations that use cognitive ability tests to select employees experience higher levels of profit and sales growth. Their study indicates that there is reason to expect a positive effect of ability testing on economic development in a country-level analysis.

1.3.3. Measure 3: monetary returns to education

The association between ability score and job complexity was named above as the most straightforward measure of allocation of talent (see Measure 1). But that measure is available only for a small number of countries. That is why I will also use a less than ideal but easier to find substitute: the association between education and wages. Economists call it monetary returns to education — how much more money do people typically earn if they stay in school for one more year. Education has always been considered a good proxy for ability and wages are a reasonably good proxy for job complexity (see Section 1.2). Hence the use of education–wages correlation as a measure of allocation of talent. The stronger the positive association between education and wages in a society, the higher should be the rate of economic development of the society.

It must be remembered, however, that education is not just an indicator of ability, talent and skill, it is also an indicator of social privilege. The fact that educated people usually earn more money could, therefore, mean that education and good jobs have been monopolized by privileged social classes (Bowles & Gintis, 2002). Comparative literature on returns to education indicates that the returns are highest in Africa and Latin-America (Psacharopoulos & Patrinos, 2004). A reasonable guess is that in these regions education is mostly a privilege of the rich and the education–wages correlation is, consequently, a sign of unequal access to resources rather than a sign of efficient allocation of talent. In more developed regions of the world the opposite could be closer to the truth. In the following analyses, I will take these remarks into account.

1.3.4. Measure 4: monetary rewards in complex occupations

In a society that uses its talent efficiently, people with higher ability should be found in jobs of higher complexity. But why should talented people be willing to do the complex jobs? Probably not out of desire to serve their country but, more likely, for the rewards these jobs offer. More complex occupations usually have higher wages and other desirable characteristics (see Section 1.2), which presumably draw talented people to these occupations (Murphy et al., 1991). The evidence, reported in Section 1.2 about the correlates of occupational complexity came mostly from the United States. But what about other countries? Perhaps in some countries there is no correlation between occupational complexity and wages. If so, then in such countries talented people would have much less motivation to work in complex occupations and the allocation of talent would be less efficient. Therefore, it is reasonable to suggest that the stronger the positive association between occupational complexity and occupational wages in a society, the higher is the rate of economic development of the society.

1.3.5. Allocation of talent in U.S. states

Because shortage of data is a problem for many of the measures described above, I will supplement the analysis of countries with the analysis of U.S. states. It seems reasonable to assume that if the measures of allocation of talent are positively related to the economic development of countries, they should also be positively related to the development of states in the USA. Several studies have confirmed that the relationships that exist at the country-level also exist at the state-level (Allik & Realo, 2004; Kanazawa, 2006). The measure of allocation for which the best state-level data are available is the monetary returns to education (education–wages correlation). Therefore, I will analyze the effect of education–wages correlation on the economic development of states, expecting to find a positive effect. Such result would raise the overall credibility of the ideas developed in this paper.

1.4. How to study economic development?

Economic studies of the wealth of nations (e.g., Barro, 1991; Barro & Sala-I-Martin, 1995) typically use cross-national data from Year 1 to Year n on the growth rate of per capital Gross Domestic Product (GDP) as a measure of economic development. Thus, the dependent variable is not really the achieved *level* of economic development but the average economic *growth* during a period. Analysis of growth is preferred over analysis of level because the developmental level of each society originates in distant history and it would be difficult to find predictors that are not themselves influenced by that level (Bosworth & Collins, 2003) — a critique that applies to Lynn and Vanhanen's (2002, 2006) study of national IQ as a determinant of societal prosperity and the papers following their lead (e.g., Hunt & Wittmann, 2008; Kanazawa, 2006).

Typically, a regression analysis is run with the average GDP growth from Year 1 to Year n as the dependent variable and possible determinants of growth at Year 1 as independent variables. GDP at Year 1 is included among the independent variables; in so doing, the analysis controls for the starting level of economic development and investigates the changes that happened after Year 1. The predictors of economic growth should be measured at the time of Year 1, capturing the social conditions that prevailed at the start of the period of study. I excluded countries from analysis if the closest available data point for a predictor was too far away from Year 1. The length of the period, to be analyzed in this paper, is 12 years. A period of 12 years is sufficiently long for systematic differences in growth rates to be revealed. Several economic studies have analyzed a period of similar length (e.g., Knack & Keefer, 1997).

A serious methodological problem for the present paper is small sample size. For some of the measures of allocation of talent the number of countries with available data is very limited (around 20), which obviously threatens the credibility of the analyses. I will compensate for that by using multiple measures of allocation. Even if the analyses involving some of the measures are small in sample size, having several analyses with different (but theoretically connected) measures should, in the end, give us a picture of how the construct of allocation of talent is related to economic growth. That is why it is not so important to look at any single result but the general pattern of results.

In order to properly evaluate allocation of talent as a possible causal determinant of economic growth, the regression analysis should control for alternative possible determinants of growth. Previous research has found many economic and social variables to have an impact on growth (see Barro & Sala-I-Martin, 1995). As a result, growth regression models are often stacked with dozens of predictors. In this paper, it is not possible to construct regression models with so many predictors because of the small sample size: if a regression model has too little cases per predictor it becomes overfitted and can yield "fake significant" results that will not replicate in other samples (Babyak, 2004). Therefore, I will use just one control variable (in addition to starting GDP): the average score on academic achievement test. This variable is known to have a strong positive effect on economic growth (Hanushek & Woessmann, 2008). It is of special interest for the present paper because it estimates the average level of talent in society. In a study that tries to establish the *distribution* of talent as a determinant of growth, it is important to control for the *level* of talent to be able to say that distribution makes a difference even among societies with equal average level.

2. Method

2.1. Data and variables

Data used in this paper came from different sources; the sources will be described next along with the construction of the variables.

2.1.1. Measures of economic development

In order to analyze economic growth during a period, it is necessary to have data on *GDP at the start* (per capita GDP in U.S. dollars in the first year of the period, transformed to a logarithmic scale) and *GDP growth rate* (the average per capita GDP growth in percentages during a period of 12 years). For country-level analysis, both of these measures were taken from the Penn World Tables (PWT, version 6.3), a widely used data set that contains information on several key economic indicators for a large number of countries.[2] For state-level analysis, the measures were taken from the website of the U.S. Bureau of Economic Analysis.[3] The 12 years over which the *GDP growth rate* was averaged are not the same in all analyses because data for the predictors (measures of allocation) came from different periods. Thus, the years of GDP growth had to be approximately "matched" to the years of the predictors (see Section 2.1.2).

2.1.2. Measures of the allocation of talent

2.1.2.1. Effect of ability on wages in a country. To compare countries in terms of the effect of people's ability on the complexity of their jobs I used data from the International Adult Literacy Survey (IALS), a comparative study of "literacy ability" conducted in 1994, 1996 and 1998, in 20 countries. Respondents of IALS filled a background questionnaire and took a test of literacy ability, which has been described as "denoting a broad set of information-processing competencies" (OECD, 2000: x). As the first proxy for occupational complexity, I used respondents' wages. To obtain a measure of ability–wages association, I ran linear regression analyses within each country with wages as the dependent variable and literacy ability, age and gender as independent variables (using only individuals aged 26–65). For each of the 20 countries I, thus, obtained the unstandardized regression coefficient (B) of the effect of ability on wages, controlling for age and gender. These regression coefficients were used in the country-level analyses to predict the *GDP growth rate* in 1995–2006.

2.1.2.2. Effect of ability on occupation in a country. In order to have an alternative look at the relation between ability and job complexity in the IALS, I used data on occupation.[4] The IALS coded the occupation of its respondents into the categories of International Standard Classification of Occupation (ISCO). Among these categories, managers and professionals possess the highest level of prestige and authority, and also get the highest complexity ratings (see Gottfredson, 1986b; Menes, 2008; Roos & Treiman, 1980). I used binary logistic regression analysis to obtain, for each country, the unstandardized regression coefficient of the effect of ability on being a manager or professional, controlling for age and gender. The coefficients were used to predict the *GDP growth rate* in 1995–2006.

2.1.2.3. Use of ability tests in recruitment in a country (% of organizations). Information on the percentage of organizations in different countries that use ability tests in recruitment was obtained from the Cranet survey (Dany & Torchy, 1994), as well as from Salgado and Anderson (2002), Terpstra and Rozell (1993), Salgado, Viswesvaran, and Ones (2001), Taylor, Mills, and O'Driscoll (1993) and Gowing and Slivinski (1994). All in all, I found data for 20 countries. All the data come from reasonably representative samples of organizations in a country and refer to the usage of cognitive ability tests, aptitude tests, or something similar. The data were collected in the first half of the 1990s. The percentages were used to predict GDP growth in 1995–2006.

2.1.2.4. Use of ability tests in recruitment in a country (Ryan, McFarland, Baron, & Page, 1999). An alternative source of cross-national data on the usage of ability tests is the survey conducted by Ryan et al. (1999). In 1996 the authors

[2] The PWT data set can be downloaded at http://pwt.econ.upenn.edu/php_site/pwt_index.php.

[3] The data for U.S. states can be downloaded at http://www.bea.gov/regional/index.htm.

[4] These data are available for 19 countries.

contacted organizations in 18 countries asking them to report on various personnel practices, including the use of cognitive ability tests in recruitment. Each organization had to report the frequency of usage on a 5-point scale, with 5 meaning "almost always or always". For each country, Ryan et al. reported mean values on the 5-point scale. These mean values complement the data described in the previous paragraph in predicting GDP growth in 1995–2006.

2.1.2.5. Effect of education on wages in a country. Numerous studies on the monetary returns to education (i.e., the effect of education on wages) have been conducted in various countries. Psacharopoulos has, through the years, assembled an impressive collection of the results of these studies (Psacharopoulos, 1985, 1993; Psacharopoulos & Patrinos, 2004). Psacharopoulos reports the return rates to education in a country in percentages (how many percentages wages usually increase with one additional year of schooling). His reviews cover several decades but I used data from 1979 to 1988; for that relatively short period I was able to find estimates of the returns for 50 countries. These estimates were used to predict GDP growth in 1985–1996.[5] The estimates were taken from Psacharopoulos (1993) or Psacharopoulos and Patrinos (2004).

2.1.2.6. Effect of education on wages in a U.S. state. The most representative regional estimates of the returns to education in the USA can be obtained from population census data. I used the 1990 census 5% public use sample to calculate the percentage returns to education within each U.S. state.[6] For that I ran linear regression analyses within each state with income from wages (in logarithmic scale) as the dependent variable and education (in years of schooling), age and gender as independent variables, using employed individuals aged 26–65. The regression coefficient of education was transformed into percentage return (see Jencks, 1979: 27). The percentages were used to predict the GDP growth of states in 1991–2002.

2.1.2.7. Effect of occupational complexity on occupational wages in a country. To estimate the size of the pay advantage enjoyed by complex occupations in different countries, one needs a cross-national data set that contains information on average wages in occupations of different complexity. The Occupational Wages Around the World (OWW) database reports average wages in U.S. dollars for a number of occupations in over 100 countries from 1983 to 2003 (see Freeman & Oostendorp, 2001).[7] To obtain information on the complexities of occupations, I used the scores of occupational cognitive complexity reported by Roos and Treiman (1980, Table F-2). I matched these complexity values with the wage data for the same occupations in the OWW database.[8] I used wage data from the 1980s to be as close temporally as possible to the complexity data, which were collected in the 1960s and 1970s. Then I ran linear regression analyses within each country with occupation as the unit of analysis, occupational complexity as the independent variable and average occupational wages (in logarithm) as the dependent variable. Each country thus got the unstandardized regression coefficient representing the effect of occupational complexity on occupational wages, which were used to predict GDP growth in 1985–1996. I only used countries with wage data for more than 32 occupations; that gave me the final sample of 53 countries.

2.1.3. Control variable

Information on the *Average test score* (the average score of students in international student achievement tests) of countries was obtained from Lynn and Meisenberg (2010). These test scores are obtained from international student assessment studies (e.g., PISA) and are transformed into IQ metric. For missing countries, I used the national IQ score from Lynn and Vanhanen (2006). For the analysis of U.S. states I used the average 4th grade test scores of the National Assessment of Educational Progress (NAEP) from the 1990s.[9] NAEP scores have been used by McDaniel (2006) to estimate the "state IQ".

2.1.4. The sample of countries

The countries with available data for allocation of talent do not constitute a representative selection from all the countries in the world; developed countries are overrepresented (see Appendix A for the list of countries). The results of the country-level analysis cannot, therefore, be carelessly applied to the poorer regions of the world.

2.2. Method of analysis

The empirical analysis of this paper strives at establishing how well the different measures of allocation of talent predict the economic growth rate. A simple method to analyze that would be ordinary least squares (OLS) regression analysis but this was not the most appropriate method here because many of the variables contained outliers. Outliers can distort regression results, therefore, I used robust regression, a form of linear regression, which gives the outlying cases smaller weights and thereby keeps them from having too much influence on regression coefficients (see Rousseeuw & Leroy, 1987). Robust regression has been successfully applied in the study of economic growth (Colombier, 2009). There are several robust estimation techniques available; the choice of the appropriate technique depends on the type of outliers present in the data (i.e., whether the outliers are more on the x or y axis). If no outliers are present, then OLS would be the preferred method. I followed the steps described by Dehon, Gassner, and Verardi (2009) to choose the best method for each regression analysis.

[5] All socialist countries were excluded from the analyses of the 1985–1996 period, because of the radical changes these countries went through during that period.

[6] The census data can be downloaded at http://usa.ipums.org/usa-action/variables/group.

[7] The wages database can be downloaded at http://www.nber.org/oww/.

[8] An obvious shortcoming of this procedure is that the occupational complexity scores constructed in the United States are being assigned to countries all over the world. Still, sociological research on occupations assures us that occupations have essentially the same substance in all societies (Treiman, 1977).

[9] The NAEP data can be downloaded at http://nces.ed.gov/nationsreportcard/naepdata/.

Table 2
Correlations among the measures of allocation of talent and other variables (sample size in parentheses).

	1.	2.	3.	4.	5.	6.	7.
1. Effect of ability on wages in a country	1						
	(20)						
2. Effect of ability on occupation in a country	.49	1					
	(19)	(19)					
3. Use of ability tests in recruitment in a country (% of organizations)	.42	.13	1				
	(14)	(13)	(20)				
4. Use of ability tests in recruitment in a country (Ryan et al., 1999)	−.03	−.67	.38	1			
	(10)	(9)	(15)	(18)			
5. Effect of education on wages in a country	.56	.16	.39	.42	1		
	(11)	(11)	(14)	(12)	(50)		
6. Effect of education on wages in a U.S. state	–	–	–	–	–	1	
						(51)	
7. Effect of occupational complexity on occupational wages in a country	.44	.28	.09	.23	.66	–	1
	(10)	(10)	(10)	(9)	(21)		(53)
8. GDP at the start	−.16	−.26	−.20	−.42	−.29	−.32	−.34
	(20)	(19)	(20)	(18)	(50)	(51)	(53)
9. Average test score	−.06	−.17	.37	.03	−.24	−.46	−.48
	(20)	(19)	(20)	(18)	(50)	(51)	(53)
10. GDP growth rate	.42	.49	.42	.16	−.05	.20	.00
	(20)	(19)	(20)	(18)	(50)	(51)	(53)
Mean	0.46	1.15	32.07	2.77	9.35	9.64	0.15
Standard deviation	0.11	0.25	18.74	0.72	3.72	0.93	0.06

3. Results

3.1. Preliminary statistics

The values of all the variables are reported in the Appendix A. An informative thing to do first is to see how the measures of allocation relate to each other (see Table 2). Given that they all should measure the same thing, one would expect positive intercorrelations between all the measures.[10] Indeed, most of the correlations are in the "right" direction (13 out of 15 correlations are positive) suggesting that a common underlying construct is being measured. Table 2 also reports correlations between allocation of talent, *GDP at start* and *Average test score*. Almost all the correlations are negative; thus, talent appears to be more efficiently allocated in poorer societies and in societies with lower average ability. That might seem surprising but, in fact, it could be a sign of societies losing their economic "edge" as they become affluent (Ervasti, 2012). One also has to note that most of the correlations are based on limited samples that do not include really poor societies.

3.2. The effect of allocation of talent on economic growth

Now, let us proceed to the analysis of the relationship between allocation of talent and economic growth. Table 3 presents the results of the regression analyses predicting GDP growth. All in all, Table 3 contains results from 14 separate runs of regression analysis, which I report all in the same table, to save space. The upper part of the table presents the regression coefficients of the seven measures of allocation of talent, the lower part indicates which control variables were included in the analysis (the coefficients of the control variables are not reported). For each measure of allocation, there are two regression models (I and II). Model I includes two independent variables: one measure of allocation and *GDP at the start*; Model II includes three independent variables: one measure of allocation, *GDP at the start* and *Average test score*. Thus, all the measures of allocation were entered into analysis one at a time; it was not possible to enter more than one measure of allocation into the same analysis because of sample size limitations.

What interests us most in Table 3 is the overall pattern of results. The pattern is in accordance with the hypotheses proposed in Table 1. Of the 14 regression coefficients, all are in the hypothesized direction; 3 are significant at $p < .05$ and 7 are significant at the more lenient $p < .10$ level.[11] As a rule, the coefficients in Model II are stronger than in Model I, indicating that it is important to control for the average test score to reveal the effect of allocation of talent. The hypothesized effects are found in the analysis of countries and also in the analysis states.

Majority of analyses in Table 3 are based on small samples. Only two of the country-level measures of allocation (*Effect of education on wages in a country* and *Effect of occupational complexity on occupational wages in a country*) have samples that are satisfactory in size. So let us take a closer look at these two measures. The coefficients of the *Effect of education on wages in a country* are both in the right direction but neither is statistically significant. However, it was explained above that the positive relationship between education and wages is probably a sign of two opposing social phenomena — economic efficiency (allocation of educated people into high-paying jobs) and social inequality (privileged access of upper-class kids to education and jobs). To remove the influence of

[10] The correlations reported in Table 2 are Spearman rank correlations. I preferred these (over Pearson correlations) because of their lesser sensitivity to outliers (Abdullah, 1990).

[11] The standardized coefficients used here are the robust standardized coefficients introduced by Nielsen and Alderson (2001). Robust standardized coefficients are less sensitive to outliers than ordinary standardized coefficients.

Table 3
Overview of regression analyses predicting economic growth.

	Dependent variable: GDP growth rate				
	Model I		Model II		
Independent variables	B	β	B	β	N
Measures of allocation of talent					
Effect of ability on wages in a country	2.80	0.21	3.68	0.27*	20
Effect of ability on occupation in a country	1.48	0.29*	1.74	0.34**	19
Use of ability tests in recruitment in a country (% of organizations)	0.02	0.55**	0.02	0.50*	20
Use of ability tests in recruitment in a country (Ryan et al., 1999)	0.36	0.43	0.17	0.21	18
Effect of education on wages in a country	0.07	0.16	0.10	0.24	50
Effect of education on wages in a U.S. state	0.08	0.10	0.23	0.29**	51
Effect of occupational complexity on occupational wages in a country	6.21	0.20	11.96	0.38*	53
Control variables included					
GDP at the start	Yes		Yes		
Average test score	No		Yes		

Note. The table contains results from 14 separate regression analyses. The measures of allocation of talent were entered into the analysis one at a time with control variables (i.e. each analysis contains only one of the measures of allocation and one or two of the control variables). B — unstandardized regression coefficient, β — standardized regression coefficient, N — sample size, GDP — gross domestic product.
* $p < .10$.
** $p < .05$.

the latter phenomenon, I excluded the poorest countries from the analysis (because in these, mostly African and Latin-American, countries education is presumably an indicator of upper-class status rather than ability). After excluding countries with the 1985 per capita GDP below 3000 dollars and running the regression analyses again the coefficients of the *Effect of education on wages in a country* increased: $B = 0.18$, $\beta = 0.43$ ($p = .08$) in Model I and $B = 0.14$, $\beta = 0.35$ ($p = .10$) in Model II ($N = 40$).

As for the *Effect of occupational complexity on occupational wages in a country*, the coefficients of this variable are also in the right direction and one is significant at the $p < .10$ level. A curious feature of this variable is that the OWW data set (the source of occupational wage data) is biased towards poorer societies and several developed countries have no data. To see if it has any effect on results, I excluded countries with the 1985 GDP below 3000 and ran the regression analyses again. As a result, the regression coefficients in both models increased considerably: $B = 18.88$, $\beta = 0.56$ ($p = .005$) in Model I and $B = 19.42$, $\beta = 0.58$ ($p = .01$) in Model II ($N = 36$). This result and the similar result in the previous paragraph indicate that the positive effect of allocation of talent on growth is more pronounced in wealthier societies.

4. Discussion

4.1. Overview of results

This paper was based on the idea that the abilities and talents of people living in a society can be utilized with various degrees of efficiency depending on how people with different talents are allocated between jobs of different complexity. An efficient allocation, where more talented people are employed in more complex occupations, should be favorable to economic growth. The purpose of this paper was to offer theoretical and preliminary empirical arguments in support of this idea. I constructed several measures of allocation of talent and analyzed their effect on the economic growth rate of countries and U.S. states. Overall, the analyses confirmed that the societies that have formed a tighter match (stronger positive correlation) between people's talents and job complexity are more successful in economic terms. These findings support the idea that talent allocation is one of the factors that determine the wealth of nations.

Clearly, the allocation of talent is not some all-important master cause of economic growth. It is just one of the many causes. The results of this paper suggest that allocation of talent is more important, as a factor of growth, among the wealthier societies. Thus, the societies that manage to pull themselves out of poverty with the help of other resources (such as the overall level of ability or education) can then further facilitate the growth of their economy by having their intellectual resources efficiently distributed.

4.2. Connection to previous research

In order to better grasp the position of the present paper, let us look at some related research. The views described in this paper are connected to some old disputes about the importance of ability testing in personnel selection (Gottfredson, 1986a; Hunter & Schmidt, 1982, 1996). In particular, Hunter and Schmidt have argued that increasing the use of ability tests in personnel selection should enhance the economic development of the society. This paper supported their argument: societies with higher prevalence of ability testing develop faster, probably because ability testing helps to allocate talent more efficiently by putting workers into occupations that correspond to their ability. Another close relative of this paper is the economic research on the allocation of talent (Hassler & Mora, 2000; Murphy et al., 1991; Torvik, 1993). The main difference between the economists' treatment of allocation of talent and the present one is the way occupations are characterized: economists characterize occupations by their productivity while the present paper (and most of psychological research) focused on complexity.

It is important to reiterate the difference between the present paper and the research that investigates the connection between average ability and economic development (e.g., Hanushek & Woessmann, 2008; Lynn & Vanhanen, 2002). Concentrating on average ability is the dominant approach to

understand how individual ability can affect societal development. But the present paper tried to find an alternative approach. It said nothing about how talented people are *on average*, it was about the *distribution* of individual ability in society. The analyses showed that the societies that are equal in terms of the average level of intellectual resources can still have different growth rates because some societies have allocated their intellectual resources more efficiently.

Comparing the two ways that talent can influence economic development – through average level and allocation – it seems that allocation might have a practical advantage. The average ability of a population is extremely difficult to change. It is virtually impossible within the national IQ framework of Lynn and Vanhanen (except through massive migration). It is not quite impossible within the economic framework, which conceptualizes ability as a learned skill rather than a genetically determined trait; but economists also contend that changing the skill-level of an entire nation is a formidable task (Hanushek & Woessmann, 2008). Changing the allocation of talent seems a lot easier given that in this case there is no need to create any new human resources but just work with the resources already at hand. Promulgating the use of ability tests in personnel selection seems to be a reasonable strategy for improving the allocation of talent; raising the wages of complex occupations could be another strategy. Even TV shows like Britain's Got Talent could make a small (but widely broadcasted) contribution to a more effective sorting of talent — Susan Boyle probably makes a larger input to British economy now, after her triumph in the 2009 Britain's Got Talent.

4.3. Suggestions for future research

Several methodological details in this paper can be improved upon. Arguably, the most visible problem is small sample size in many of the analyses. Therefore, the first obvious suggestion for future research is to repeat the analyses with a larger data set to see if the results extend to other countries. In the future there will, hopefully, be more countries with available data on the relationship between ability and job complexity or the prevalence of ability testing. In addition to countries, other units of analysis could be used (e.g., states, organizations). A larger sample would also allow us to construct more sophisticated regression models, because the present analysis can be criticized for controlling for only two alternative causes of economic growth (GDP at the start and average test score), thereby leaving the door open to the possibility that the effect of allocation of talent on GDP growth is spurious, caused by some third variable that affects allocation and growth. Finding this "third variable" might be quite difficult because there seems little theoretical basis for suggesting why some countries have a better allocation of talent than others.

Another suggestion for future research is to consider possible historical and inter-societal variations in the level of job complexity. In this paper it was implicitly assumed that all societies are equal in average job complexity. But apparently this is not the case. Social scientists have for some decades now written about life and jobs becoming more cognitively demanding (Herrnstein & Murray, 1994; Hunt, 1995). There is evidence that the skill requirements of several jobs are rising (Handel, 2003). Is that relevant to the allocation of talent? It should be. In a more complex society, the matching of ability and jobs should acquire greater importance because there are more jobs around that could potentially be too complex for some people. Readers familiar with the Flynn effect might reply that the trend of increasing job complexity could be offset by the trend of increasing intelligence (and education) among the workers. If workers are becoming more intelligent and skilled, then they should be better equipped to take on the increasingly complex jobs. The present paper cannot decide how these two historical trends ultimately affect the importance of talent allocation. This is an interesting topic of further investigation.

The third, most theoretical, suggestion concerns the conceptualization of allocation of talent. The conceptualization in the present paper can be described as one-dimensional: both people and occupations were characterized by a single dimension (ability and complexity). But reality is more multifaceted. It has already been noted that economists prefer to characterize occupations by their productivity. A generalized theory of allocation of talent should take account of both complexity and productivity, and possibly other characteristics of occupations. In such two-dimensional framework the top-occupations would be the ones that are complex as well as productive, these occupations would require the brightest talents. For that framework to be developed, economists should work out more detailed measures of occupational productivity — something similar to occupational complexity scales. People also have more features than just their overall cognitive ability; they have physical ability, personality traits, interests. All these attributes can be used as a basis for matching people to jobs (although all the attributes might not be equally important for economic development). What emerges is a complicated picture of matching people to jobs on multiple dimensions. That picture might be too complicated to handle right now, that is why the present paper took a simplified approach.

4.4. Conclusion

No doubt, the results of this paper are preliminary. Much more research is needed before the role of allocation of talent in economic development is properly understood. Several authors from different disciplines have suggested that allocation of talent should have consequences for societal functioning (Davis & Moore, 1945; Gottfredson, 1986a; Murphy et al., 1991). So there is sufficient reason to consider it a topic worth investigating. The analyses of this paper allow us to be rather optimistic about the idea that the economic faith of societies depends on how people with different talents find their place in society.

Appendix A. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.intell.2013.03.002.

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